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STANDARDS IN EDUCATION.

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The past decade has witnessed a widespread effort to determine standards of efficiency in commercial pursuits and in municipal, state, and national expenditures. In view of this movement no one can be surprised that the vast outlay for education should be subjected to somewhat the same scrutiny which other business has received. The larger phases of such investigations are represented by studies which have been made of the entire educational system of states. Thus the Carnegie Foundation for the Advancement of Teaching has made, at the request of the Vermont Educational Commission *A Study of Education in Vermont,* published in 1914 as Bulletin No. VII of the Foundation. The study has been complete and sympathetic, but the conclusions drawn therefrom have not received the approval of many sincerely interested in education. *The Preliminary Report on Conditions and Needs of Rural Schools in Wisconsin,* published in 1912, is based upon field study under the direction of the New York Bureau of Municipal Research (Wm. H. Allen, Director). *The Report of the Ohio State School Survey Commission to the Governor* is a coöperative field study conducted by Horace L. Brittain, Director of Survey of the New York Training School for Public Service. The suggestions made in these studies are highly practical and based largely upon methods in actual use in efficient school systems. The concluding statement of the Résumé of the Ohio report is worth quoting: "All schools should be standardized and the graduates of lower schools should be eligible for admission to a higher school without state examinations. Institutions should be standardized rather than students or pupils. All standardization should be concerned with the quality as well as with the quantity of work done, and the greatest freedom should be allowed each individual school to develop its individuality along the line of service to the community."

Another study on a large scale is that made of the New York

City school system under the direction of Professor Paul Hanus of Harvard (author, we may mention, of a book on determinants but now a teacher of pedagogy). *The Report of the Committee on School Inquiry and Apportionment,* City of New York, 1911-1913 (in three large volumes of 820, 829, and 924 pages), is now available in most large libraries of the country.

I wish to direct particular attention to the standardization of work in arithmetic, along the lines suggested by S. A. Courtis in articles in various journals and in the New York *Report* (Vol. I, 389-546).

In the tests conducted in New York and in many other cities the following points were made the subject of examination:

1. Addition combinations, $0+0$ up to $9+9$.
2. Subtraction combinations, inverses of the preceding.
3. Multiplication combinations, 0×0 up to 9×9.
4. Division combinations, inverses of the preceding.
5. Copying figures, 0, 1, 2, 3, . . . 9.
6. Speed reasoning, on simple problems and questions.
7. Fundamentals.
8. Reasoning.

In all grades wide variations were found but the attempt is made to set a standard of achievement for each grade to which a large majority of the children in each grade should attain. Thus the average scores in New York City schools in the multiplication combinations are 29 per minute in grade 4, with 35, 38, 41 and 46 per minute in the four following grades. The standard scores for these five grades based upon these and other average scores are set at 23 per minute in the fourth grade, and 30, 37, 41, and 45 in the fifth to eighth grades. The intent of the work is that drill should be given until the pupil attains about the standard score for his grade, but with this attainment drill for increase in this speed should cease, and the child's energies directed in other channels. Two bulletins[1] have been issued by Mr. Courtis, which describe more in detail the tests and the results. A new series of tests for arithmetic is now being used. This takes up particularly the four fundamental operations: column addition of nine 3 place numbers; subtraction of 8 place numbers from 8 and 9 place numbers; multiplication of 4 place by 2 place numbers; division of 4 place or 5 place numbers by 2 place. In each of these new tests the pupil is given eight minutes to work as many problems as possible, being cautioned that he is not expected to

[1]Bulletin Number One, 15c, Detroit, 1912; Bulletin Number Two, 15c, Detroit, 1913.

work all the problems given (about 24 of each type). Each operation is tested separately.

Mr. Courtis suggests that the new series of more practical tests be tried rather than the tests on the tables. In thirty-five Elementary School Districts of Boston these later tests (series B) have been applied and the following table of tentative standards in the number of examples attempted is in every case within 10% of the average medians attained by each grade in the 35 school districts tested. The number of correct answers varies materially from these scores.

Grades.	IV.	V.	VI.	VII.	VIII.
Test 1, Addition	6	7	9	10	11
Test 2, Subtraction	6	8	9	10	12
Test 3, Multiplication	4	6	7	8	9
Test 4, Division	3	5	6	7	9

The defects of our system of training are indicated by the wide deviations from standard scores found in all of the grades tested. Thus in the eighth grade in Boston some 3,500 pupils were tested. Eleven problems attempted is set as the normal standard for this grade in the type of problems in addition which we have mentioned. Of these 3,500 children, more than 50% attempted less than eleven problems, while 30% of all attempted from thirteen to twenty-four of these problems; but of these two-thirds made errors in adding. In the fifth grade, with the same problems, nearly 10% of the 4,367 children who made the tests attempted eleven or more, and in the sixth grade nearly 20% of all who were examined did as well. Similar variations are found in the number of examples worked correctly, with much overlapping of grades. Thus 198 out of 4,143 sixth grade children worked 11 to 23 examples correctly, while in the eighth grade only 665 out of 3,464 did eleven or more without error. The lack of uniformity of achievement shown by the great variability of the products of the public school in these points, to which the schools devote their attention, indicates a state of affairs which demands serious consideration by educators.

Similar tests are being attempted for the work in English, in spelling, in writing, and experiments in these directions have been suggested by Leonard P. Ayers of the Russell Sage Foundation and by Professor Edward L. Thorndike of Teachers College, New York, as well as by Mr. Courtis.

In this connection it seems desirable to call attention to a set of number tablets devised by Prof. Thorndike[2] for his selected

[2]*Exercises in Arithmetic* by Edward L. Thorndike. Frank O. Beattys & Co., 393-397 Lafayette St., New York. Nos. 1, 2, 3, 4, and 5. Pupil's edition, 10 cents each. Teacher's edition (with answers), 15 cents each.

exercises, "graded and arranged to meet the requirements of the hygiene of the eye and neuro-muscular apparatus." Thus the tablets for the second and third grades are in much larger type than those for the upper grades. These tablets are greatly to be commended as a step in the right direction, namely, adapting the number material in every way to the child at the stage of development which he has attained.

Courtis says, "Measure the efficiency of the entire school, not the individual ability of the few." Such tests as those we have outlined not only measure the efficiency of school, but even better, they point out the particular weaknesses of individual students. Diagnosis thus being made, training can be directed to remedy the defects as revealed. Also the laggards and the brilliant pupils can be determined more readily and exactly. The deficients can be segregated for the industrial training which they need, while the more brilliant students can be advanced as rapidly as their abilities permit. Ultimately the schools must treat each individual as an individual and adapt in a large measure the instruction to individual needs. Such tests will make this possible.

THE PTOLEMAIC AND PYTHAGOREAN THEOREMS, FROM AN IDENTITY.

By T. M. Blakslee.

If AB, BC, CD are consecutive sects, as vectors, x, y, z,

$$x \cdot z + y(x+y+z) \equiv (x+y)(y+z).$$

$$\text{i. e., } AB \cdot CD + BC \cdot AD \equiv AC \cdot BD.$$

If ABCD is inscribable, these products have the same direction.

Direction of AB $= \frac{A+B}{2}$, of CD $= \frac{C+D}{2}$.

Direction of AB · CD $= \frac{A+B+C+D}{2} = \frac{S}{2}$.

Direction of BC $= \frac{B+C}{2}$, of AD $= \frac{A+D}{2}$.

Direction of BC · AD $= \frac{S}{2}$.

Direction of AC $= \frac{A+C}{2}$, of BD $= \frac{B+D}{2}$.

Direction of AC · BD $= \frac{S}{2}$.

∴Ptolemy's theorem, as every rectangle is inscribable if its sides are aa, bb and diagonals cc. $a^2+b^2 = c^2$, proving the Pythagorean theorem. Other notations can be used.

HIGH SCHOOL AND COLLEGE DUPLICATION IN SCIENCE: EDUCATIONAL EFFICIENCY.

By Geo. J. Miller,
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Efficiency is the watchword of modern progress. That our educational system could not stand the "acid test of efficiency" is well known. Among the defects is the unnecessary duplication of subjects. It has been proven that at least one year's time can be saved in the elementary school by simply organizing the subject matter properly. The next move is to save another year during the present eight year high school and college period. From the examination of the records of a large number of university graduates Dr. Angell has shown that "fully one-third of their entire college course was given to work which could have been pursued in any one of our better high schools." It is obvious, therefore, that with proper coördination a student can complete his high school-college course in seven years, thus giving him one year earlier start in business or professional life. That such a lack of coöperation exists is certainly a weak spot in our educational system for which a remedy should be found at once. No modern business could long survive under such a wasteful management. Such conditions are tolerated only in public affairs.

Another source of waste that should be mentioned, though it will not be discussed here, is the insufficient use of our educational plants. Our high school students are in school only a few hours for five days in the week and for 36 to 40 weeks each year, and even this short time is broken by numerous vacations and holidays. This is about as wasteful a use or rather a misuse of time as can be imagined. If study and recreation periods were as well organized as our present "recitation periods" there would be no burden in more hours each day, six days in each week and for ten to eleven full months each year. That there are certain stock arguments against such a revolution is well known, but they are the arguments of the "standpatter" and he is always a temporary obstacle in the path of progress.

A comparatively few years ago there was a sharp line of demarcation between the colleges and secondary schools. The latter at that time were distinctly preparatory institutions and similar in character to many present-day private schools. Their courses of study were stereotyped in character, aiming at one

purpose. Since these schools prepared their students to continue work in selected colleges, there was little or no duplication. The modern public high school, however, has broadened its curriculum until it is impossible for a student to complete within four years what is offered. This has led to the introduction of a much wider range of elementary subjects in some colleges, i. e., high school courses, to enable the student to attack new lines of study.

There is undoubtedly some justification for this. On the other hand there is much overlapping of many subjects. Some of this overlapping may be justified but most of it is wholly unnecessary. It seems reasonable to assume that the college would much prefer to rid itself of elementary instruction and devote that energy to work of true collegiate grade. If secondary school teaching is so poor that the student must begin again when he enters college the responsibility rests on the high school teacher, and the sooner that teacher recognizes the responsibility, the sooner waste can be eliminated. There recently came to my attention a geography written by university teachers for use in their classes. This text is little more than ninth or tenth grade geography. Its use in college classes reduces that work to at least the grade of a good high school, yet the university credits that work toward a degree. When similar work is done thoroughly in a secondary school, why should a student be compelled to duplicate it when he enters college? Why should it not be accepted and thereby shorten his college course to that extent?

The non-recognition of high school work is justified usually on the ground that the college work is done better and the students are more mature. The latter reason is a fact, the former is an assumption which certainly would not hold in many cases. In fact, the college recognizes certain subjects as having been done sufficiently well for entrance and builds its work upon that preparation. In other cases it accepts them for entrance but directs the student to begin over again. This is the case in the sciences. It is unfortunately true that many of the elementary college courses are taught by graduate students. To my personal knowledge some of these embryo teachers never taught a day in their life until the unfortunate freshman class confronted them. In other cases these teachers had not even studied the courses that were given them to teach, yet the college assumes that their work will excel that done in the better high schools by experienced teachers. What is the natural result of this? The college instructor finds that the freshman does not know certain facts

that he teaches, and, therefore, complains of the bad high school preparation. Such instructors cannot understand how anyone could have the presumption to differ from them about the particular facts that should be taught, nor can they realize that the high school teacher blames the elementary school, the elementary school the kindergarten, and the kindergarten the parents. This condition indicates a great need of friendly coöperation. I do not hold that no high school instruction is bad, but wish to point out that not all bad teaching is done in the high school. High school as well as college teachers should come to realize that it is *ability to do* and not an encyclopedic knowledge of facts that indicates good teaching, and is the essential thing in an education for life. It is also unfortunate that many university men look upon all high school teaching as inferior and unworthy of their consideration. These instructors attach so much importance to their college position—even though it be a petty one—that they refer to high school work with little short of contempt. That this indicates little comprehension of our better high schools is obvious. The overcoming of this prejudice by doing work worthy of consideration is one of the problems that the high school teacher must solve. I believe that if they are given a chance to show what they can do that they will not be found wanting.

It is not to be assumed that this coöperation will be effected unless there are definite advantages. It has been pointed out that at the present time (1) selected high school courses are accepted for college entrance; (2) that some college departments recognize their efficiency and build upon them; (3) that other departments require the student to begin again, in other words, they accept the subject for entrance and then disregard it. This means that a large percentage of college work consists in beginning again. Obviously there is something wrong when a student can carry his college work side by side with one who has had high school training in that subject. This again points to the need of coördination. The gain to the college will include (1) the elimination of most of its elementary courses, (2) economy of time for strictly collegiate courses, (3) economy of time for the student, and (4) release of funds for advanced work. In the high school it would economize the student's time, encourage better work, lead to the selection of better teachers, the supply of ample equipment, and replace the feeling that colleges are trying to dominate the high schools by a feeling of coöperation and sympathetic interest.

Coördination of High School and Elementary College Sciences.

What is the relationship of the sciences to this problem? The first question to decide is, are the first college courses in the sciences elementary? If high school courses are not to be recognized, or if the subjects are not suitable for the high school then the college courses are not elementary. However, since most of the sciences are now taught in the high school we can at least agree that (1) the college courses are preparatory in character, and (2) that they are duplications of the high school courses. This is doubly true when the high school and college texts have been written by the same author. In the latter case the high school work is poor indeed, if it does not prepare the student to continue the next more advanced course in college.

This leads to enquiry into the present status of high school science subjects in our better high schools. What is accomplished? Is the work unsatisfactory? If so, what are the contributing factors and the remedies? At present one-half of a full year, consisting of five to ten hours each week, is devoted to each of the sciences. It should be borne in mind that the question is not simply whether the present courses are equivalent, but whether they can be so organized as to be made equivalent, and at the same time not interfere with the high school performing the most efficient service to the local community. The latter requires coöperation. If we are to decide that the present courses are not satisfactory equivalents, the reasons and the remedies should be determined. Some of the factors that contribute toward inadequacy are (1) immaturity of the students, (2) necessary elementary character of the work, (3) lack of proper school equipment, and, (4) poorly prepared teachers. The first two depend upon the individual ability of the students and upon the year in which the courses are given. The removal of the third and fourth causes will be hastened by a sympathetic coöperation of college and secondary school. Such coöperation is the most important remedy.

What are the criteria for determining the equivalency of college and high school courses? They would include subject matter, time given to the course, maturity and ability of the student, quality of the teaching, and amount of equivalency sought. With the possible exception of the quality of the teaching, all these points can be agreed upon by coöperation. The quality of teach-

ing can be determined only by trial. The high school teacher must be willing to assume responsibility for their own students. They must realize fully that when one of their students enters the more advanced college course that they, as well as the student, are on trial. Any high school teacher who is unwilling to assume this responsibility has no reason to expect college recognition of his work.

Since nothing but trial will ever prove the desirability or undesirability of an economy in education along these lines, and since discussions that offer no definite solution are useless, I suggest the following as a working plan.

1. Subject matter and time given to the course be accepted as they now stand in accredited high schools.

2. Maturity and ability of students be determined by limiting (as a trial) the privilege to third and fourth year students who have a grade which is higher than the school's passing grade by an amount equal to 50% of the difference between the passing grade and 100, and who are recommended by their teacher.

3. That individuals rather than schools or courses be made the basis for recognition.

4. That ability to continue successfully the more advanced course be the basis for judging the student.

5. That the number of courses for which equivalents are accepted be deducted from the total number required for graduation from college, the total reduction of time not to exceed one year.

There would not be many students affected for the first few years but the number would soon become larger as the possibilities of the plan became known. I am convinced that the inauguration of this or a similar plan will not only result in a greater economy of the student's time, but will bring about a closer coöperation between the colleges and the secondary schools. This means a sympathetic relationship that will be of inestimable value to both institutions. It will also be an epoch-making step in the progress of education. In the high school it will put a premium on the doing of high grade work and encourage the student to continue his work in college. It will necessitate better equipment and will encourage the employment of qualified teachers. Any superintendent will hesitate to select teachers not qualified to maintain a standard once established. That this closer relationship between college and secondary schools is desirable and is certain to come in the future is assured and every teacher should hasten its accomplishment.

INDUSTRIAL GAS CALORIMETRY.

For many years all laws and regulations relating to manufactured gas were based on candlepower requirements, i. e., the gas burned in a definite burner at the rate of 5 cubic feet per hour was required to give a specified illumination of so many candlepower. This specification furnished a perfectly satisfactory control of the quality of gas delivered so long as the gas was chiefly used for illuminating purposes with the old style of open-flame gas burner. At the present time, however, this inefficient type of burner has been very largely displaced by burners of the Welsbach mantle type. Furthermore, a large amount of the gas sold today is used for cooking purposes and to some extent for operating small gas engines for power purposes. In these applications of gas it is the heating value that is of first importance and not the candlepower. It has been estimated that less than 20 per cent of the gas manufactured and sold today, indeed in many of our cities and towns less than 10 per cent, is used in the old type of open-flame gas burners. Notwithstanding this fact we still find in most of our cities and towns ordinances on the statute books requiring that the gas meet a definite candlepower test, while no attention has been given to the question of heating value, which is the important factor for over 80 per cent of the gas sold. Many of the candlepower requirements fixed by law are quite high, often requiring the manufacture of an expensive oil-enriched gas, which may not be the most economical gas to the public. The importance of the heating value of the gas is now being quite generally recognized, and where new legislation has been adopted recently and where public-service commissions have considered the question of gas regulation and have gotten to the point of issuing regulations, the heating value standard is being generally adopted, supplemented in some cases by a moderate candlepower standard, the latter with a view to affording the necessary protection to those who still use the open-flame burner.

In view of the growing importance of the question of heating values of gases from the manufacturing, the legislative, the inspecting, and the economic sides, the Bureau of Standards, of the Department of Commerce, started several years ago an exhaustive investigation of the instruments widely used in this country and abroad to measure the heating values of gases, with a view to determining the sources of error to which the instruments are liable, the important precautions to be observed in their use, and the accuracy attainable with them. This investigation has now been completed, and the results will be published in a forthcoming technologic paper, reprints of which may be obtained by those interested in the subject by addressing a written request to that Bureau. It is expected that the paper will come from the press about June 1st.

AMERICAN RADIUM MARKET CLOSED.

The European war has, for the present at least, totally closed the European market to American radium ores. As is well known, the uranium ores of Colorado and Utah are sold exclusively for their radium content, so little use being known for the uranium that the ores can not be sold for their content of that element. The condition of the European market leaves the miners without a buyer; so that while the war lasts, and probably for some time afterward, the market will be restricted and without the benefit of competition.

As has been pointed out by Secretary of the Interior Lane, had the bills introduced in Congress been passed, the United States Government would probably have been in the market as a buyer, and the miner might now have a chance to sell his ore.—*Bulletin 599, U. S. Geological Survey.*

AN ELEMENTARY COURSE IN GENERAL SCIENCE: CONTENT AND METHOD.

BY W. F. ROECKER,
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I. THE HISTORY OF GENERAL SCIENCE.

To most of us this subject appears so new that we are inclined to look upon it as an intruder. We are so used to the vertical division of natural science into subjects carefully established by book covers and various other more or less artificial means that we hesitate to admit that there may be a cross-section of the sciences which is worth looking at. And yet a little reflection will tell us that the knowledge embodied in our courses in physics, chemistry, biology, etc., came to us from nature in a very heterogeneous condition.

The records of the N. E. A. show discussions akin to what we have today as far back as 1869 and as late as 1912. Most of the early papers are an attempt to make science popular; the object seems to have been to get recognition for the sciences in school programs so they might hold a place there on a par with other subjects. The industrial evolution during the past twenty-five years has made such efforts unnecessary today; the sciences are now looked upon as necessary essentials of a school program —at least in secondary schools.

Since 1890, general science, as distinct from departmental sciences, has received special consideration. Departmental sciences lacked the thread of continuity and the cement of coördination. High school sciences were justly looked upon as difficult because no previous early training had been provided for to furnish the foundation on which to build—an apperceptive mass. As a remedy we then have the "Nature Study Idea" and later also courses in general science—the former for the grades, the latter for upper grades and high school.

The fundamental conceptions underlying courses in general science seem to have been first stated by Wilbur S. Jackman of Illinois, according to the N. E. A. reports of 1891 and 1895, where may be found a paper each on "Natural Science for Common Schools" and "Coördination in Natural Science." These papers give us no light on the details of such a course but they are classics in pointing out the guiding principles for such work.

At present this subject is spreading rapidly in this state and throughout the country. This is largely due to the satisfactory

reports which have been received from the prominent centers in which the work has been given a trial. Springfield, Mass., Pittsburgh, Pa., Oak Park, Ill., Providence, R. I., Bridgeport, Conn., Illinois State Normal University, Normal, Ill., Wichita, Kansas, Gary, Ind., and Madison, Wis., may be mentioned as such centers. Most of these schools have developed some kind of a manual and organized their course according to some specific type. Thus at Oak Park physiology is made the unifying subject; in Bridgeport, mineralogy serves the same purpose. At Normal, Illinois, physics is made the primary part of the subject, while in Madison (City High School) elementary biology forms the core. At Gary, Ind., a kind of monitorial system exists whereby the lower grades may learn from those above them in rank and age. Prof. Hodges of Cornell University has become a great exponent of nature study; Prof. John F. Woodhull of Columbia University is at present interested in elementary science; the Horace Mann School is offering this work in the sixth grade. Prof. John G. Coulter of Bloomington, Ill., is an experienced teacher of this subject and emphasizes practical biology—agriculture in particular.

In Wisconsin elementary science has received specific attention by the state department; since 1910 this subject has received mention in the Manual for Free High Schools. The rapid development of rural or agricultural high schools undoubtedly has been a factor in its extensive adoption in recent years.

II. The Demand for Elementary General Science.

It may be of interest to inquire why there is such a demand for a course of this kind, and what the advantages are which it offers.

1. It furnishes fundamental science experience.

The recent movement to modify the teaching of physics, chemistry and other sciences has no doubt influenced many to plan for some preparatory science which may furnish that foundation for the want of which the so-called advanced sciences often fail to give satisfactory results. There is no line of studies in the high school for which there is not several times as much preparation made in the grades as there is for the sciences. This holds true even today, after the nature study idea has influenced many school systems. It is only natural that the high school should anticipate this difficulty by offering some elementary course during the first year, thereby relieving later courses from the extreme modification necessary to obtain the best results.

2. It furnishes interesting and useful information.

Coördination with the environment for self-protection and improvement is the life problem which the child faces and elementary science offers him help to see and solve this problem. This is an age of great industrial progress—the age of steel and electricity, of mechanical wonders and scientific miracles. Science and service have become inseparable; it is a big factor in the survival of the fittest. Its spirit is everywhere—even the humblest laborer recognizes it. No wonder he wants his son to get as much as he can of this field of knowledge, even though he cannot give him a complete secondary education. In this sense elementary science is the poor boy's hope.

3. It cultivates a scientific attitude of mind and teaches the pupil to organize his life experiences.

The fact that our environment is modified and controlled so largely by scientific agencies makes it important for every child that its powers of observation and interpretation be well trained. In this day and age we need a scientific attitude of mind in order to get along successfully. A child has a wide scope of observation and can acquire knowledge that would surprise adults. It is the interpretation of observations which functions as the power of the scientific mind. Professor Jackman puts it well when he says: "A child and a goat may see the same thing, with the advantage of vision on the side of the goat; but the latter has no power to interpret what he sees, and is, therefore, essentially non-scientific." The mental attitude and the faculty whereby we see the elements of our environment in their true light should be cultivated early; it should certainly not be delayed until the later years of a high school course.

4. It gives excellent results, is interesting and has an adaptable, practical content.

III. Present Status of Elementary Science in Wisconsin.

A questionaire was sent to 89 schools in Wisconsin which at the beginning of this school year seemed to offer general science as part of the high school program. 53 replies were received, three of which were blanks accompanied with explanations that this subject had just been introduced and had not yet been given any attention. The remaining fifty sets of answers represent a variety of schools from all parts of the state. In many cases the course has been given for two or three years, so that the data obtained rest upon positive experience.

(A) *Returns on the Questionaire.*

1. Given in what year? First, 49; second, 1. How long? Half year, 27; one year, 22. Semester? Both, 22; first, 19; second, 6.

2. Purpose of the course?

(a) General information, 33.
(b) Preparation for later sciences, 31.
(c) To take place of some science, 11.
a, b, and c, 12; a and b, 4.

3. Is the work required or elective? Required, 37; elective, 10; both, 2.

4. Why was this course introduced into your program?

(a) To give general knowledge of science, 19.
(b) Basis for agriculture, 11.
(c) For non-graduates, 7.
(d) Substitute for physical geography, 5.
(e) Practical and needed, 6.
(f) Required by state, 3.

When? '09, 1; '10, 3; '11, 7; '12, 18; '13, 14; seven for more than four years.

5. What text is used? Clark, 31; Higgins', 17; Avery and Sinnott, 3; various, 3; none, 1.

6. What laboratory or field work is given?

(a) Teacher performs experiments, 22.
(b) Class and teacher perform experiments, 10.
(c) Manual is followed, 7.
(d) Experiments done at home, 5.
(e) None, 7.
(f) Two periods a week, 8; three periods a week, 11.

7. Are note books required? Yes, 37; no, 13.

8. What references are used? None, 13; everything obtainable, 10; elementary science books only, 9; elementary physics and chemistry, only, 9; advanced physics and chemistry, 3; magazines, 5. References: Tarr's *Physical Geography,* Higgins' *First Science Book,* Clark's *General Science,* Rowell's *General Science,* Bergen's *Botany,* Kahlenberg's *Chemistry,* Walker's *Physiology,* Bailey's *Sanitary and Applied Chemistry,* Hopkin's *Science,* Hoadley's *Physics, Popular Mechanics, Harper's Magazine, Agricultural Bulletins,* and the *Encyclopedia.*

9. How much time per week is given to this work? 1 hour per week, 2; 2 hours, 1; 5 hours, 44; 6 hours, 1; 7 hours, 2.

10. Should it be given for a half or a whole year? Why?

(a) Half year, 11; because,
1. One semester is enough, 5.
2. A year's work becomes too extended.
3. Other studies are needed.
4. Student should study for himself.

(b) Whole year, 34; because,
1. Too large a field for one semester, 25.
2. The work is practical and useful, 4.

(c) Depends on character and method of work, 4.

11. Do you have any systematic teaching of science below the high school? If so, what is its nature and in what grades? None, 26; physiology, 7; agriculture, 10; nature study, 4; domestic science, 1.

12. Do you think that this course could profitably be extended over several years? Let us say twice a week throughout 7th, 8th, and 9th grades? Yes, 22; yes, if teachers are prepared sufficiently, 5; doubtful, 6; no, 10.

13. What sciences furnish material for this course? All sciences, 7; physics, 39; chemistry, 36; physical geography, 15; botany, 13; physiology, 11; agriculture, 8; biology, 4; geology, 3; weather, food study, nature study, domestic science, zoölogy, and astronomy.

14. Is the emphasis of attention placed upon biological phenomena or physical phenomena? Do you have any experimental evidence supporting either position? Biological, 2; physical, 39; both, 3. Experimental evidence, 15; none, 12.

(a) Freshmen too young for biology.
(b) Teachers are prepared to teach physics and chemistry
(c) Botany not so well received as general science.
(d) Children had more experience in physical phenomena.
(e) Students find physical phenomena more interesting.
(f) Botany should present some biology.
(g) Physical phenomena are better suited to other courses.

15. Is each science taught as a unit, or is the subject taught topically regardless of scientific unity? Small science units, 10; topically, 29; both, 6; part of agriculture, 1.

16. To what extent do you aim to secure control, by developing general underlying principles? i. e.; Is the course informa-

tional, broadly or definitely organized and administered with reference to scientific ends? Informational, 23; definitely organized, 8; both, 9; neither particularly, 2.

17. Is the text used satisfactory? If not, why not? Satisfactory, 23; not satisfactory, 12; fairly satisfactory, 12. Because,
   (a) Too brief, 7.
   (b) Too technical, 4.
   (c) Wrong method used.
   (d) Not enough household chemistry.
   (e) Not enough simple experiments.
   (f) More illustrations needed.

18. Fitness of teacher in this subject?
   (a) Preparation: University graduate, 9; normal school graduate, 16; college, 8; some university work, 12.
   (b) Specialty: Science, 13; chemistry, 6; physics, 3; agriculture, 6; botany, 3; mathematics, 3; manual training, 1.
   (c) Experience: None, 4; 2 to 4 years, 12; 6 to 15 years, 13. Subjects: Physics, chemistry, botany, agriculture.

19. Has the course given satisfactory results? Specify. Yes, 34; cannot say, 5; only fairly, 4.
   1. Pupils very interested, 15.
   2. Stimulates interest in science, 7.
   3. Course is practical, 7.
   4. Keeps pupils in school, 3.
   5. Aids in teaching advanced sciences, 7.
   6. Explains everyday phenomena, 10.
   7. Course very popular, 3.
   8. Good for English and physiology.

(*B*) *Summary.*

The aggregate returns here given contain a number of elements which appear very definite and on which the common experience in Wisconsin is quite uniform and the common judgment of those interested in this problem is decidedly in accord. These points may be stated as follows:

1. General science should be given as a first year subject in the four year high school; it should extend over a year, five times per week; it should be required in all English and scientific courses and offered as an elective in all other courses.

2. The course should be of an elementary nature, be presented

topically, and should be based on physics, chemistry, earth science and biology.

3. The course should be largely informational and practical but sufficiently organized to serve as a basis for future study of sciences, and it should be approached by the inductive and experimental method.

4. This course, to be successful, must be taught by an experienced teacher well versed in the sciences.

5. Unless a special course has been developed a text should be used to outline most of the work.

6. Science should receive some systematic attention in the grades.

IV. The Purpose of a General Science Course.

In the light of the experience of those who seem qualified to make reliable judgments on this question we may conceive the purposes of a course like this to be as follows:

1. To furnish a well adapted and practical fund of general science information, at a time when the assimilative power of the child is great.

2. To give training in the observation and the interpretation of vital points in the environment, thus cultivating a scientific mental attitude.

3. To lay a broad foundation for work in further science study.

4. To give a coördinated or "bird's-eye" view of relationships in nature.

5. To cultivate an appreciation of the importance of scientific knowledge for present day existence, comfort and progress.

V. The Organization of the Course.

While there are a number of points on which we can agree quite readily there are others on which opinions may differ radically. The most serious of these appears to be: Shall this work be presented as information topics, or as pure science units or subjects? Mr. V. G. Barnes of the Madison High School takes one side of this question in the N. E. A. report of 1912 where he states, "The teacher of physics or chemistry or any other science who tries to get out of a subject any more than the fundamental principles is making a big mistake. The first work in any science should be the teaching of the pure science. Think of the age of the student; his mind is not mature—he cannot take the general

law and make specific applications of that general law to concrete cases." On the other hand Wilbur S. Jackman sees the other side of the shield in the N. E. A. report of 1891 where he states: "It is a radical error to attempt to make specialists of the pupils from the beginning." "The arrangement of the subjects so that one shall in turn succeed another in regular order is a device which has done most in obscuring the relations of the so-called branches of science to each other and to the child. However necessary such an arrangement may be for an advanced course, in elementary work there is not the slightest foundation for it either in nature as it presents itself for study or in the conditions under which the child's mind develops. Nor is it so important, as many teachers suppose, to use the material afforded by any particular subject in a fixed order."

The procedure of giving sciences subject by subject, primarily emphasizing principles and orienting the abstract as well as the concrete, may be justifiable in advanced classes where the unity of the subject is paramount. For elementary science this is not the case. The acquisition of important, positive, related facts regarding the material at hand should be the primary aim. To accomplish this best the course should be given in a series of familiar topics each of which should be simultaneously viewed from the standpoint of all the sciences bearing on it. For many topics the physical and chemical will predominate; in some the biological element will receive primary attention. This plan seems to be most successful in the various centers where general science has received attention for some time; it also seems to be decidedly the more satisfactory in Wisconsin schools at present.

It is a well known fact that the German secondary schools give training in nature study to students from about the age of ten on. Examination of a number of elementary German science texts of recent publication shows almost invariably that the work is presented in topics with various sciences combined as suggested. A quotation from Russell's *German Higher Schools* gives a brief account of how this work is viewed in Germany. "Evidence is not wanting to show that the sciences are not taught as distinct subjects, but as a means of assisting the individual to a more complete realization of his environment. Pedagogic writers emphasize repeatedly the futility of attempting to give the preparatory student a thorough knowledge of the principles of even a single science; this is the work of the university. The aim of the secondary schools should be to provide such training as will enable

the student when he enters upon his university career to begin the study of any science intelligently. In other words, an understanding of the relations existing between sciences is of more worth than an extensive knowledge of any one."

VI. Content of the Course.

The following outline includes exercises for a whole year; in fact it contains more than can be accomplished under ordinary circumstances in that time. A course of this kind to be generally applicable must necessarily carry some excess baggage in order that it may be adapted to differences in teachers and communities. For a half year course some topics should be omitted bodily and of the exercises in the remaining topics only those should be covered which seem of greatest value for the particular school and community.

(*a*) *Introduction.*

1. How do we distinguish between physical and chemical changes?
2. What is meant by an element? A mixture? A compound?
3. How do living things differ from those without life?
4. What are some of the practical applications of science with which you meet in daily life?

(*b*) *Air.*

1. Does air have weight?
2. Does air exert pressure and how great is that pressure?
3. Of what use are weather maps and how are they made?
4. Is air an element, or a mixture of gases?
5. What is it that is burned out of the air and what are its properties?
6. Is oxygen necessary to support life?
7. What is formed when wood, coal or oil burns in air?
8. Is carbon dioxide added to the air by the breathing of animals?
9. How can we measure the amount of carbon dioxide in the air?
10. How may carbon dioxide be prepared and what are its properties?
11. Does air contain moisture?
12. How can we tell how moist the air is?
13. Why is it that so much air must be pumped into a bicycle tire to fill it for use?

14. How does a bicycle pump work?
15. How does a vacuum cleaner work?
16. What makes a balloon rise?

(*c*) *Water.*

1. What does a cubic foot of water weigh?
2. Does a stone weigh as much in air as in water?
3. Does water exert pressure and how does it compare with that of the atmosphere?
4. How does the common lift pump work? (Cistern.)
5. How does the force pump work?
6. Is water an element, or a compound?
7. How may hydrogen be prepared and what are its properties?
8. Does common well water, or city water contain anything in solution?
9. How is water distilled?
10. How is water filtered?
11. How can you tell hard water and how may it be softened?
12. Does water change its volume when freezing?
13. Is water necessary to make seeds germinate?
14. What per cent of a potato is water?
15. How do the root hairs absorb water?

(*d*) *Fire and Flame.*

1. How are candles made?
2. How does the candle burn?
3. Is fresh air necessary to keep a candle burning?
4. What gives off the light in the candle flame and where is the flame hottest?
5. How does the Bunsen burner work? The blast lamp?
6. How is the gas made which is used in Bunsen burners and gas stoves?
7. What products are formed in the hot gas flame?
8. What is necessary to start a fire, and what is meant by the kindling temperature?
9. How are matches made?
10. What is meant by the flashing point of an oil? And what is the flashing point of gasoline and kerosene?
11. What makes an oil dangerous and what rules should be observed in handling gasoline?
12. What conditions are necessary to cause an explosion?
13. How is gunpowder made, and how is it exploded?

14. How does wood burn? Soft coal? Hard coal?
15. How is charcoal made? Coke?

(*e*) *Heat.*

(*f*) *Light.*

(*g*) *Some Simple Machines.*

(*h*) *Acids, Gases and Salts.*

(*i*) *Electricity.*

(*j*) *Minerals.*

(*k*) *Foods.*

(*l*) *How Plants Live and Grow.*[1]

1. Seeds. Conditions necessary for germination and growth. Simple structural parts of plants.
2. Root. Its functions.
3. Stem. Its functions.
4. Leaf. Its functions.
5. Flower. Functions.

Structural adaptations to the various uses.

Study of a few plants to show their modifications for special purposes. For example, corn plant, morning glory, nasturtium.

(*m*) *How Animals Live and Grow.*

1. General study of animals.
2. Comparison with plants.
3. Conditions necessary for the fly.
4. Study the life history of one or two economic animals; for example, the toad.

(*n*) *Trees, Shrubs and Vines.*

1. Trees—Oaks: red, white, bun, scarlet; maples: soft, hard; box elder; golden willow; white poplar; cottonwood; basswood; fir balsam; arbor vitae; elms: white, red, cork; spruce: white, Norway; pines: white, jack, Norway; tamarack; paper birch; red cedar.
2. Shrubs—Juneberry, red osier dogwood, bush honeysuckle, buckthorn, syringa, sumac, yellow flowered currant, elder, spirea, lilac.
3. Vines—Virginia creeper, clematis, grape.

This work should be of some assistance to the pupil in the decoration of home grounds. Topics: Identification, prominent characteristics, winter identification, adaptability to use for orna-

[1]Note: For the biological aspect of the work outlined in this course, credit is due to Prof. Geo. A. Works, recently of the University of Minnesota, and now of Cornell University.

mental purposes. In addition to the forms mentioned there should be included some of the more common forms characteristic of the community. Thus, in southern Wisconsin the shagbark hickory is very common; in the northern part of the state it would be hard to find material for class room work.

Method: This work will need to be largely laboratory study and field trips to handle it to the best advantage. There should be opportunity for work during fall, winter and spring.

(o) Insects.

Fly, moth, butterfly, mosquito, grasshopper, potato beetle, spider, bees, dragon fly, ants.

1. General characteristics.
2. Study of life history.
3. Field work.
4. Opportunity should be provided to observe some of the insects through the winter and to see their spring development.

Example, moth. Economic phases should be emphasized in such cases as the fly and the mosquito. The pupils should be encouraged to make collections.

(p) Birds.

Robin, meadow lark, cow bird, red winged blackbird, grackle, English sparrow, swallows—barn and bank, mourning dove, flicker, belted kingfisher, redheaded woodpecker, downy woodpecker, kingbird, bobolink, junco, chickadee, northern shrike, sparrow hawk, phoebe, Baltimore oriole, song sparrow, goldfinch, house wren.

Topics:

1. Identification.
2. Economic importance of birds in general and special study of birds whose usefulness is noteworthy.
3. Means of attracting birds.
4. Legislation for protection of birds: state and national.
5. Interesting modifications to adapt a bird to its mode of life; example, bill, or long legs of waders.
6. Nesting habits.
7. Migration.

Observations should be taken from time to time. Perhaps the best time to begin work is with winter residents; the nest can be located in the fall and winter months and may become incidental to the study of trees.

VII. Typical Exercises.

1. Does air have weight?

Exhaust the air from a flask and counterbalance it on a fairly sensitive balance. Open the stopcock so as to let the air re-enter. Results?

a. How is the weight of the vessel affected when the air is pumped out of it?

b. How could you answer this problem with an electric light bulb?

c. What is a vacuum?

d. How could you find the weight of a cubic foot of air?

e. If 12 cubic feet of air weigh a pound, how much does the air in the laboratory weigh?

2. What per cent of a potato consists of water?

Wash a medium sized potato and dry it. Weigh it carefully. Slice it into a saucer; care should be taken to make the slices thin and not to lose any of them; weigh the saucer with the potato. Heat over a water bath, or in a drying oven until the slices are very dry and appear like potato chips. Weigh again.

a. How do you account for the loss of weight?

b. What fraction of the potato was water? What per cent?

c. How did the water get into the potato?

d. What vegetables do you think contain a large per cent of water?

VIII. Method.

J. G. Coulter in the 1912 Report of the N. E. A. makes the following points which should govern the method of this work.

1. There may be variety in content but in method we must look for similarity. We have here what may be called the "science of science education."

2. Aims.

a. Lessons whose aim is appreciation of science, 10%.

b. Lessons whose aim is information, 60%.

c. Lessons whose aim is training; science experience, 20%.

d. Lessons whose aim is application of science method to non-science problems, 10%.

From personal experience the following points may be mentioned as important and helpful:

1. The exercises should be made short, simple and inductive.

2. There should be something to do in each exercise that will solve a problem. Under ideal conditions much of the experimental work should be done by the pupils. Under the conditions we have usually the teacher must demonstrate most of the exercises; get the pupils to assist you as much as possible.

3. Much can be made out of home demonstrations.

4. Excellent demonstrations are often suggested, brought to class and demonstrated by pupils having home advantages.

5. Recitation reviews should be exercises in oral expression.

6. The written work should be small in amount, in good form and English, and it should be developed as board work in the beginning.

7. Liberal use should be made of the expression of ideas by means of diagrams and drawings.

8. The historical aspect is often fascinating to young people.

9. The importance of what is learned should be emphasized by bringing out its utility.

10. Children love to assist in gathering the material necessary for study purposes.

11. Select and present exercises with special reference to community interests and the sciences which are to follow.

12. Relate one topic to another.

IX. Textbooks, Manuals and References.

(*a*) *Texts and Manuals.*

1. *General Science*—Clark. American Book Co.
2. *General Manual*—Clark. American Book Co.
3. *First Science Book*—Higgins. Ginn.
4. *The Sciences*—Holden. Ginn.
5. *Nature Study*—Overton and Hill. A. B. Co.
6. *Introductory Science*—Teachers. Bridgeport, Conn.
7. *Sixth Yearbook*—Sup'ts and Prin's Ass'n of N. Ill. University of Chicago Press.
8. *General Science*—Rowell. Macmillan.
9. *First Year Science*—Russell and Kelly. Henry Holt.
10. *Elements of Physical Science*—Barber. Normal, Ill.
11. *Nature Study and Elementary Science*—Curriculum, Horace Mann School, Columbia University.
12. *Elementary Science Manual*—Thalman and Weckel, Oak Park, Ill.

(*b*) *References.*

1. A simple text each in physics, chemistry, physiology, botany, agriculture, physical geography, and zoölogy.
2. *Story of Great Inventions*—Burns. Harpers.
3. *Essentials of Biology*—Hunter. Am. B. Co.
4. *Sanitary and Applied Chemistry*—Bailey. Macmillan.
5. *Inventors at Work*—Iles. Doubleday.

6. *Inventions and Inventors*—Mowry.
7. *Story of Useful Inventions*—Forman. Century.
8. A variety of selected libarary books.

In general the attention of the class should be centered on a single book if a text is followed. Reference reading should be limited to the cultivation of interest and for the satisfaction of those presenting special questions.

Texts and manuals are still far from being satisfactory but in many cases they may serve in part as a guide and may thus be of value to the teacher with limited experience. In the Wisconsin High School no text is used, but the work is outlined as here indicated; however, many of the books here mentioned are consulted as references and have been found to have elements of special value.

VOLUME OF TEXAS RIVERS.

The determination of the amount of water flowing in the streams of the Rio Grande basin, which covers the greater part of New Mexico, large areas in southern Colorado, and a considerable territory in Texas and old Mexico, is of unusual importance to that region, which is for the most part an arid agricultural country, entirely dependent on its streams for irrigation.

Water-Supply Paper 328, just issued by the United States Geological Survey, contains records for 1912 of the discharge of the Rio Grande and its principal tributaries, together with that of Brazos River and Colorado River of Texas.

The data are of international importance for it is alleged that the inequitable diversion of the water in both Colorado and New Mexico has destroyed large agricultural values in Mexico. Certain issues have also arisen between the states of New Mexico and Colorado because the people of New Mexico contend that a disproportionate part of the water of the Rio Grande originating in Colorado is diverted in that state, to the detriment of interests in New Mexico. These international and interstate complications are now being investigated under competent authority, and the results of the stream-flow measurements contained in this report of the Geological Survey constitute a part of the evidence that will be used in the final decisions. In addition to the results procured by the Survey in coöperation with the states of New Mexico and Colorado, the report contains records of the discharge of the Rio Grande proper, obtained by the International Boundary Commission, the stations at which the measurements were made being at El Paso, Presidio, Langtry, Devils River, Eagle Pass, Laredo, Roma, and Brownsville, all in Texas.

A copy of Water-Supply Paper 328 may be obtained free on application to the Director of the Geological Survey at Washington, D. C.

A DIVISION OF THE SUBJECT MATTER OF PHYSICS INTO TWO COURSES, ELEMENTARY AND ADVANCED OF ONE SEMESTER EACH.

By H. Clyde Krenerick,
North Division High School, Milwaukee, Wis.

We are told that the percentage of our high school pupils taking the subject of physics has decreased in the last decade from twenty-five to less than ten per cent. We are also informed by certain patrons of educational programs and journals, who care more for sensation than for common sense, that this is the result of our modern ways of presenting the subject. They have entirely overlooked the fact that the subject is no longer required for graduation; that the extension of curricula has increased the choice of election; that seventy-five per cent of the students entering high school never reach the grade in which the subject is offered.

However be the causes as they may, the fact remains. Is it not to be greatly regretted that a course whose subject matter is so closely related to our everyday life and experiences should be taken by so few? What is the solution To some segregation is the panacea of many of these defects. From my experiences with boys and girls, I can not feel that it is a solution that affords the greatest good to the greatest number.

The basis of classification of the great majority of our students is one of ability and aptitude rather than sex. Many girls are good in mathematics, they are interested and efficient in the quantitative and technical phases of physics. Many boys are not. Segregation with its modification of courses is an injustice to both these classes. The present day experiences of the city boy and girl are such that there are few parts of physics adapted to the boy and not to the girl, fewer parts adapted to the girl and not to the boy.

There is always a noticeable per cent of our students who have not the ability for scientific or mathematical discussions. To them the returns from the technical and quantitative portions of the subject are not commensurate with the time and effort. They are nevertheless just as interested in and capable of comprehending the general information of the subject, but the lack of perfect understanding tends toward discouragement and dissatisfaction. With the remaining portion of the class, the injustice is even greater. They are held back, their time to some degree wasted. The inability and constant drill of the others tends to encourage

laziness rather than bring out their best efforts and possibilities.

To meet this analysis of the situation and its difficulties, we, two years ago, divided the subject matter as now ordinarily presented consecutively for a year into two distinct courses, elementary and advanced, of one semester each.

In the elementary course we present the more essential and practical principles that apply to everyday life, that are suited to both sexes and possible of comprehension by practically all students. Laboratory work with its mechanically followed instructions and tedious note-book compositions is replaced by a few home exercises or problems of the nature of diagrams and explanations or tests of home appliances, of which the following is a suggested list:

Gas and Electric Meter Readings.

Relative Humidity. In living room, kitchen and outside.

Efficiency of Gas Stove. Different burners and different kettles compared.

Heating System. Hot water, hot air, steam, or coal stove. Action, construction, and manipulation.

Cook Stove. Cross-section diagram. Proper control of dampers.

Home Ventilation. Number of cubic feet per hour from registers; number of persons provided.

Gas Lights. Cost per rated candle power hour of different lights.

Electric Lights. Cost per candle power hour compared with gas.

Plumbing System. Diagram of connections of all hot and cold water pipes.

Door Bell System.

School Heating System.

School Ventilating System.

School Ventilation. Determine the number of pupils provided.

The unusual interest aroused not only in students but in parents as well by these investigations has been exceedingly gratifying. The ignorance displayed by some of the best students of the working principles of the most common home appliances is convincing that it is a much needed phase of physics instruction. At the close of the semester, I asked for an expression from each member of the class concerning the home exercises. The vote was taken in such a way that I am sure that each was sincere in his

reply. I was surprised and pleased to find that only seven out of the eighty-six would say that the exercises had not made the course more popular.

Another change that has greatly simplified this first semester course is the absolute omission of the metric system. I have many times questioned the good of so extensive a use of the metric units in our discussions in high school physics. Where is the advantage? It is to be greatly regretted that it is not universally used, but physics instruction will never produce the reformation. If it should be taught, let the mathematics department do its duty. Over ninety per cent of our students never hear of the system after leaving school. Furthermore, during the year of physics they do not become familiar enough with the units to think in terms of them. If students have to stop and think of their terms or units it clogs their line of reasoning. Common relations or magnitudes are so often expressed in our textbooks in the metric system. They mean so little at the time and are soon forgotten. During the course we do not use or refer to the metric system in any way, and I have felt many times from the results obtained that the advantages of the use of the English units were very much in evidence.

In summary, it is the purpose to have this course contain that and only that subject matter which every wide-awake boy and girl wants to know about; to make it of such value and importance that it can be unhesitatingly recommended and urged, if not required, of every high school graduate; to make it of such absorbing interest that its popularity will result in almost universal election.

After two years' experience, I believe that I am going to succeed in that purpose. In the May preceding the year in which this new system was started, fifty-three juniors enrolled in physics for the coming year. Later on it was decided to try the experiment of division, and the plan was advertised as best we could. The next September the enrollment had increased to eighty-six. Not all of the increase, however, was due to the change in the course. Seventeen did not take the advanced work, while many who had intended to take only the elementary course decided later to continue with the second.

In the second semester, or advanced course, we take the more difficult, the more quantitative mathematical and technical portions of the subject. A large portion of the time is now spent in the laboratory. One of the most satisfactory features of this

division method is the perfect correlation that is here possible between the laboratory work and the class room discussion, the lack of which, I believe, is the most serious defect of the usual plan with its fixed and definite laboratory periods as the necessity of the system compels us to have them in the larger school. Unless there is this perfect adjustment the laboratory day is bound to be a break or diversion in the class room treatment of the subject matter. We have all noticed that the intensity of our work is never up to standard in the first recitation following a holiday.

Not only is this highly desired correlation possible, but now the experiment can be performed just at the proper place in the discussion. It is often best to have the experiment precede the recitation. Many an experiment is robbed of its flavor by having been demonstrated, discussed and applied in previous recitation.

During the first four months of this advanced course, the students work in unison, the experiments are largely quantitative and for the purpose mainly of demonstrating or verifying some law or principle. During the last month, however, the work and method is somewhat changed. The students have now completed the ordinary year's work in the subject and they are now sort of turned loose to apply their knowledge of its laws and principles on a number of rather practical problems, tests, or experiments.

I now have efficient apparatus for twenty-one of these exercises. The following is a list of the titles with a word or two of explanation:

B. T. U. per Cubic Foot of Gas. Determined with a Junker's Calorimeter and gas meter.

Gas Stoves: Efficiency of different burners and different kettles.

Photometry: Candle power of different kinds of gas and electric lights.

Gas Lights: Cost per candle power hour of different types of gas lights.

Electric Heater: Cost per B. T. U. Determine watts for one B. T. U. per second.

Electric Lights: Efficiency and cost per candle power hour of different kinds and capacities.

Electric Stoves: Relative efficiency of electric and gas hot plates.

Fireless Cooker: Electric: Efficiency compared with that of exposed hot plate.

Flat Irons: Relative efficiency and economy of gas and electric irons.

Resistance of Lamps: When hot, voltmeter and ammeter method. When cold, wheatstone bridge method.

Water Motor: Horse power and efficiency. Power determined by the brake method.

Gas Engine: Operation and efficiency. Fuel measured by meter, horse power determined by brake test.

Steam Engine: Test same as for an engine.

Electric Motor: Horse power and efficiency at different loads.

Dynamo: Determine the type and function of field resistance. Current furnished for a study of voltage and amperage with different connections of 35 volt lamps.

Motor Generator: Efficiency as a transformer.

Wireless Telegraph: Operation of condensers, helix, tuning coil, etc. Transmission from lecture room to laboratory.

Tensile Strength: To find supporting capacity of suspension bridge, specifications and safety factor given.

Roof Truss: To find extra tension on tie-beam and compression on walls when roof is covered with six inches of snow.

Stiffness Factor: Beams of different materials and dimensions compared.

Strength Factor: To find supporting capacity of beam with given specifications and safety factor.

One-half of these exercises are especially suited to girls. Nearly all are of interest to the boys. As far as possible the students are allowed freedom of selection. The assignments are consequently varied to suit the interest and ability of the individual; an adaptation highly desired but almost impossible in large schools under present methods.

Some of these exercises are presented as problems. The assignments and references are given the previous day and little or no instructions are given with the experiment. A laboratory manual, with its explicit and detailed instructions, too often counteracts the very purpose of the work, for the more explicit the instructions the more mechanically will they be followed by the student. Would it not be of far greater value to the pupil if some of the exercises were of such simple requirements and apparatus that he could be compelled to rely upon his own resources for the method of procedure? For illustration, if a student has already studied density and specific gravity, would it not be better to send him to the laboratory with the simple instruction to find the density of a given object rather than with the following directions quoted from a well-known manual? "Suspend solid from counter-poise and weight. Weight is submerged in ice water.

Find difference of these weights which is the mass of water displaced. This difference divided by density of ice water will be the volume of the solid. The density of the solid will be its mass divided by its volume." As a climax this is followed by a formula and a pigeon hole device for tabulation. What thoughts on the matter at hand are required of the student to follow such instructions? Of course not all laboratory work could be done without detailed directions.

One criticism or objection that some may offer to this plan of division is that the treatment will need to be too superficial if the entire subject is to be covered in one semester. By eliminating some of the quantitative parts which always receive an undue portion of time and drill and remembering that the laboratory work takes about one-third of the time devoted to the subject, we must agree that there is ample time in one semester for the subject, matter remaining to receive just as intensive consideration as at present. Furthermore, high school physics is not a complete treatise of the subject, and no two persons are agreed as to just what should be eliminated. If we were to take only that subject matter which we find common to the recent high school textbooks, one semester, uninterrupted by laboratory days, would be sufficient time for its consideration.

It is not a difficult task, as it might at first thought seem, to divide the subject matter of physics into such elementary and advanced portions. Practically all of the subject of mechanics of fluids is covered in the first semester. In mechanics of solids, the following parts are difficult and can be left for the second semester without harm to the continuity of the elementary course: composition and resolution of forces and velocities; accelerated motion; moments; couples; and parallel forces; center of gravity, and stability; strain and stress, tensile strength, stiffness and strength factors of beams. In heat the determination of coefficients of expansion, specific heat, heat of fusion, heat of vaporization, and mechanical equivalent are left for the second course. In light the determination of candle power, indices of refraction, focal lengths; the location and construction of images in mirrors and lenses; magnifying power; and a study of the more complicated optical instruments are practically left for the second semester. The subjects of sound, magnetism, and static electricity are completed in the first semester. In current electricity the following parts are left for the advanced course: Wheatstone bridge, battery connections, parallel resistance, fall of potential,

laws of resistance, different types of motors and dynamos, transformers and alternating current machinery. It will be noticed that practically every subject to be taken in the advanced course can be accompanied by a student experiment. Hence the perfect correlation between the class room discussion and the laboratory work.

There are three more departures from the ordinary that I would like to see included before I am entirely satisfied with the system. I believe that the elementary course should be required of all students for graduation. Certain courses in English and in mathematics are required. Is it possible that there is not one science that will prepare a student for life as well as algebra? I would like to see the advanced course required of none, but offered purely as an elective. In our school as in the majority of others, one year of physics is required in certain courses. Consequently there are many girls and some boys in our classes who have not the aptitude or ability for the quantitative or more difficult parts of physics and who could be spending their time and energy with far greater profit to themselves in some other subject. With this class of students eliminated from the advanced course, the work accomplished could be of a far greater intensive and extensive character.

I would like to see the semester of elementary work offered earlier in the high school course, preferably in the sophomore year. Whether required or not, the course thus offered would attract and enlist a large majority of the students starting on their high school course. The proper sequence of science subjects is an argument in favor of this change. The elementary course as outlined above contains more fundamentals and is capable of more elementary treatment than any other physical science and consequently should be presented first.

I always felt when teaching physical geography to the freshmen and physics to the seniors that I was putting the cart before the horse. Compare the presentation of such subjects as density, specific gravity, specific heat, barometer, refraction, rainbow, lightning, magnetism, and many others in our textbooks of physical geography with that found in our textbooks of physics and in which do you find the more elementary treatment? In physical geography, judging from some textbooks we must assume that the freshmen know what we take time to develop with our seniors in physics. Physical geography, I believe, should be offered as an elective later in the high school course. I would

place the biological sciences in the freshman year. They are more observational, require less intensive reasoning, and hence should precede the physical.

The proper arrangement and unification of our high school sciences is certainly the greatest problem at present before the science teachers of the country. Our fellow teachers of the English department have set us a good example. When I was a student in high school, I had grammar in the ninth grade, composition in the tenth, rhetoric in the eleventh, and literature in the twelfth. Now we have English one, English two, and so on for the eight courses, of the four years. It would be advantageous in many ways if our physical sciences, physical geography, chemistry, physics, geology, astronomy, should be eliminated as such and their content or the desired portions of each were taken and reassembled and rearranged according to adaptation and difficulty and presented as science one, science two, and so on for the desired number of courses to be offered. The Committee on a Unified High School Science Course appointed by the Central Association has before it a great field of work.

CORN LESSONS FOR COUNTRY SCHOOLS.

For the benefit of children in rural schools suggestions for a series of lessons on corn are about to be issued by the U. S. Department of Agriculture. The average production per acre of corn in the United States is still below 28 bushels per acre despite the fact that in almost every section of the country yields of more than 100 bushels have been obtained. The difference indicates in a measure the value of proper instruction in growing corn. The spread of boys' corn clubs all over the country has also emphasized the need of corn study in rural schools.

The forthcoming bulletin contains outlines of twelve lessons covering such important points as the different kinds of corn, ways of judging corn, seed, corn crop rotation, best kind of fertilizers, proper cultivation and the food value of the crop. Suggestions for the proper observance of corn day have received consideration. Rural school teachers, especially in the great corn-growing states, will find the bulletin a valuable aid in the work of stimulating in their charges a healthy interest in sound agriculture.

This bulletin will be published under the title of *Farmers' Bulletin No. 617, School lessons on Corn,* and copies will be sent free as long as the supply lasts.

THE MOVEMENT TOWARD A UNIFIED SCIENCE COURSE IN SECONDARY SCHOOLS.[1]

By Harold B. Shinn,
Carl Schurz High School, Chicago.

The title of this report, as announced, is the result of careful editorial work on some one's part and we would correct it immediately. It would appear that there can be no real "Unified Science Course" as long as localities and their needs are different, or as long as men's minds are individual and various. Your attention is asked for only a brief statement of the current movement toward a unified science course.

Our science courses in college and high school have passed through just as distinct phases as have the developments of the microscope or the automobile. At the time of Linnaeus's first connection with the University of Upsala there was a marked movement there toward field work in natural history which so upset the equilibrium of the institution that Linnaeus was forced to resign. Attendant upon the development of the microscope was an awakening in microscopic technique. Modern research in the higher sciences has brought into our textbooks and our teaching a mass of material much of which, after trial, proves too heavy for the mind of the high school pupil. This seems to be the climax of our specialization in high school science. Hitherto we have been most interested in the proper presentation of our subjects in all their fullness and beauty; the development of the child or the man has been quite incidental.

"Certain defects of science courses in content and in methods are becoming increasingly apparent. In some respects science teaching is not as closely related to the environment and experience of the pupil today as it was a quarter century ago. With the elaboration of apparatus and the increased attention to quantitative methods there has come an aloofness from the experience of everyday life, so that the pupil may secure a high standing in physics, chemistry, or biology without necessarily gaining an understanding of their applications. Moreover, teachers in science in some instances over-emphasize the importance of formal and fixed procedure and, as a result, are not alert to utilize new opportunities."

The reaction now is toward making each subject valuable and interesting to the pupil, and toward a closer articulation of the

[1]A paper read at the meeting of the Illinois Academy of Science, Evanston, Jan. 21, 1914.

subjects as opposed to their former isolation and individualness. Courses are being compiled and fitted, being cut down here and built out there, the high places made low and the valleys filled, in order that classes may be held through the course.

The Commissioner of Education in the report for 1910 brings out the potent fact that at the then existing rate of decline physiology will cease to be studied by 1925, physics by 1935, chemistry by 1945, and physical geography by 1960. While these statements seem overdrawn, yet they do emphasize the inefficiency of our past methods of presenting our sciences and their suicidal effect.

Without entering into a lengthy discussion of conditions which we all appreciate, may we turn to the immediate topic? Within the last decade there has sprung up a great dissatisfaction with the conventional courses. This is particularly true of the teachers in the lower years of the high school, for it is they who see the enormous loss in attendance and in interest in school work. In 1892 a committee of the National Educational Association recommended the elaboration or intensification of the first year science, geography. Gradually this became too intensive and too collegiate. In 1909, seventeen years later and five years ago, geographers inaugurated a movement among themselves to react against the inattention to human response and environment, the fitting of pupils for college rather than for life, and the suppression of interest in economic or industrial facts and factors.

Apparently thus far science teachers generally have been quite willing for the first year teachers to wrestle alone with the task of revision and adaptation. In fact the others have been eager to prune back geography to almost nothing and to graft on scions of almost everything else. But they insist that their own courses, as biology, chemistry, or what-not, be left inviolate and intact.

At the present time, however, a very wide-spread movement is at work toward the revision of the entire high school course, science included. This work is partly under the direction of the National Educational Association and its committee on the reorganization of high school education. Its purpose and plans are given in Bulletin No. 41, 1913, of the United States Bureau of Education. This general committee presides over ten subcommittees or the high school departments: the subcommittee on natural science is divided into five others for (1) First Year Science, (2) Physics, (3) Chemistry, (4) Geography and (5)

Biology. The special committee on biology immediately upon its appointment broke up into many minor groups in order that all sections of the United States might be represented and at work. The special committee centering in Chicago, of which the speaker has the honor to be a member, includes representatives from Wisconsin, Michigan, Indiana, and Illinois.

It is the plan to continue this work for a period of years but to change the membership several times in order that the final report may be the work of many men and that it may be carefully formulated and revised; its first report will be collated in 1915. The general revisory committee hopes that it will:

"(a) Formulate statements of the valid aims, efficient methods, and kinds of material whereby each subject may best serve the needs of high school pupils.

"(b) Enable the inexperienced teacher to secure at the outset a correct point of view.

"(c) Place the needs of the high school before all agencies that are training teachers for positions in high schools.

"(d) Secure college entrance recognition for courses that meet actual needs of high-school pupils."

From this statement of aims the welding of the several sciences into a unified course is not, apparently, a definite and immediate purpose. Whether this result ensues is a question.

To our personal knowledge there is no other broad movement looking toward the reorganization of secondary education, although departmental sections throughout the country are engaged thereon. Notable among these is the Central Association of Science and Mathematics Teachers, a committee of which is at present working up a two-year course in general science. Its préliminary report, which was presented at the Des Moines meeting last Thanksgiving, stated in a very general way the aims in this two year "stem" course. A successful "stem" course in general science has been worked out by W. L. Eikenberry of the School of Education, University of Chicago; it was adopted by the Agricultural Section of the Illinois High School Conference last November and is outlined in the January, 1914, issue of SCHOOL SCIENCE AND MATHEMATICS.

From the accounting of the plans of the National Educational Association and of the Central Association of Science and Mathematics Teachers, and that of other isolated cases, it appears that with the possible exception of this Illinois Academy of Science no organization has yet considered the formulation of a general

course in high school science in which there shall be not only a unity or commonness of purpose and method, but even more, a closer articulation or, to put it more plainly, an almost entire absence of demarcation between the natural sciences.

As heretofore given, physiology, botany, chemistry, and others have been taught and studied as independent units. When several of these sciences were in a course there was a strong staccato effect, a marked hiatus between them and a full stop at the end of each study; often there were many of these within the subject. Thus while a so-called science course was listed the pupil studied only separate units, units just as separate and distinct as Latin and history, as mathematics and English. The broad scientific truths or generalizations probably dawned upon the pupil's comprehension, if at all, long after high school days were over. The causes of this lack of articulation were at least two: the teacher and the textbook.

There exists in the minds of certain members of this committee as probably has been stated at a previous meeting, a very admirable conception of a high school science teaching which will break down and clear away the barriers which have been the jealous boundaries of each man's domain; which will interweave the materials, the methods and the facts of all the sciences into a fabric so smooth that a pupil entering upon the science course of a curriculum will find less difficulty in beginning new subjects each year and hence will be more apt to complete the entire course. Such a course has been well marked out in English. English now is a four-year unit and no longer four solitary, independent units; the course is working excellently. In such a course the materials and information from one laboratory will be utilized in the others. The chemical, physical, biological and geographical materials will be unified.

For example: A zoölogy or physiology class, when studying the animal's eye, will begin with a simple lens, determination of principal and secondary foci, and image formation, and from this physical basis work into the use of a retina. This material, used again in the physics laboratory, will give point or application to a cold law of optics or refraction.

And throughout the course materials of study will be interchanged and utilized until the pupil realizes that no phenomenon is to itself alone but that all unite to make the whole. In such a course it may even come about that instead of the name plates on laboratory doors and in catalogs being called "Chemistry" and

"Geography," they will be "Third Year Science" and "First Year Science."

In conclusion, then, may it be stated that by "unified science" is not meant a uniform, standardized, "cut and dried" course for all teachers, all classes and all localities, but a science, the parts of which are not integers but fractions; not isolated subjects taught by trained specialists but are portions of a broad (or deep) subject, science, taught by men who specialize in the general education of youth.

SOME OBSERVATIONS ON THE STUDY AND TEACHING OF MATHEMATICS IN GERMANY.

By Professor G. N. Armstrong,
Ohio Wesleyan University, Delaware, Ohio.

(*Continued from November issue.*)

My next correspondent is a very serious-minded and studious young man from Regensburg, out near the Walhalla. I had great respect for his mathematical ability, especially on account of the thoroughness of his preparation when he appeared on the program of the mathematical colloquiums. He responded to my request for an account of his training and of the school system of Bavaria with a great deal of care and completeness. He says:

"A condition for admission to one of our intermediate schools is to be of the age between 9 and 12 and to give evidence of the necessary ability by means of an entrance examination, which covers the branches of instruction in the Volkschule. These are: numbers from 1 to 1000; simple narrations of things which have been told the pupil; orthography.

"Our intermediate schools consist of nine classes and fall into three different groups:

"Humanistische Gymnasien (specially emphasize Latin and Greek).

"Realgymnasien. These agree in work with the humanistische Gymnasien for the first three classes and not until the fourth year does a separation occur.

"3. Oberrealschulen. These emphasize the modern languages, mathematics, natural science, and chemistry.

"With regard to the mathematical instruction in each of these institutions one may set forth the following outline in general:

	Geometry.	*Algebra.*	*Trigonometry.*
HUM. GYMN.	1) Study of triangles, polygons, the circle, exercises in transformations and subdividing.	1) Linear equations with one or more unknowns, quadratic equations with one unknown, involution, logarithms, arith. and geomet. prog.	1) Computation of plane triangles with the simple laws; simple exercises in goniometry, elements of astronomy.
REAL GYMN.	1) Study of triangles, polygons, the circle, exercises in transformations and subdividing. 2) Analytic geometry of circle and straight line. 3) Introduction to descriptive geometry. (Discontinued from next year.)	1) Linear equations with one or more unknowns, quadratic equations with one unknown, involution, logarithms, arith. and geomet. prog. 2) Combinations, probabilities, extraction of roots and solution of equations by approximation methods, chief laws of determinants. 3) Complex numbers, de Moivre's theorem.	1) Computation of plane triangles with the simple laws; simple exercises in goniometry, elements of astronomy. 2) The simplest laws of spherical trigonometry.
OBER REAL SCHULE.	1) Study of triangles, polygons, the circle, exercises in transformations and subdividing. 2) Analytic geometry of line, circle and conic sections. 3) Synthetic geometry of the plane. 4) Descriptive geometry.	1) Linear equations with one or more unknowns, quadratic equations with one unknown, involution, logarithms, arith. and geomet. prog. 2) Combinations, probabilities, extraction of roots and solution of equations by approximation methods, chief laws of determinants. 3) Introduction to series, convergence tests, exponential, binomial, trigonometric, logarithmic series. 4) Complex numbers, de Moivre's theorem, important theorems of the theory of equations. 5) Elements of diff. and int. calculus.	1) Computation of plane triangles with the simple laws; simple exercises in goniometry, elements of astronomy. 2) Intensive study of spherical trigonometry.

"In physics, at the Oberrealschulen, laboratory work is required from the students. There are also class demonstrations. All scholars perform the same experiment and the discussion of the theory is based upon this. At present in the Gymnasien the labor-

atory exercises are elective, but it is expected that a change will take place in the coming years. The pupils will make experiments in order that they may find their results as verification of the theory later given them.

"The certificate of any one of these intermediate schools gives the permission to enter a university or technical high school. (For the Realgymnasien and the Oberrealschule theology is excluded; for the Oberrealschule the study of law and medicine are permissible only by special examination in Latin or by successful study of this branch as an elective during the school course.)

"There is no special course of study for the teacher of mathematics. A selection of studies, however, naturally arises out of the conditions set for the examinations.

"The usual course of the studies is about as follows:

"The first four semesters the subjects of instruction in the Oberrealschule are pursued, with a deepening and extension of the same; also experimental physics.

"The first section of the state examination is taken. This covers these subjects; also German composition. To be admitted to this examination one must present evidence of attendance upon lectures of a philosophical or historical nature.

"The next four semesters: analytical geometry of space, line geometry, synthetic geometry of space, differential geometry, differential equations, number theory, theory of functions; possibly elliptic functions, multiple and definite integrals, etc., theoretical physics, possibly, with the study of some special branch of the same, and physical laboratory. Then comes:

"Second section of the state examination.

"This extends in general over the above mentioned branches with special attention to the courses pursued by the candidate. Further there is included the theory or history of pedagogy. A condition for admission to the examination is the presentation of a minor piece of independent research. Finally to this there comes the attendance for one year upon a pedagogical-didactical seminar in connection with an intermediate school.

"The candidates are required to attend usually six to eight of these seminars per week, that is about ten school hours, dealing with mathematical and physical questions, and also select some from the other branches in order to become familiar with the method of conducting the institutions. For the first few weeks of the seminar work exclusive attention is paid to the mathematical-physical portion and the candidates are mere listeners. Then the candidates begin to instruct in these branches in the presence of

other candidates and the regular class teachers of the branch in question. If this teacher is not a seminar teacher himself there must also be a seminar teacher present. Now and then there is present the director of the seminar. Finally during the last quarter year the candidates impart instruction independently in the classes.

"Twice a week there are seminar conferences. The director of the institution has these in charge, and he as a rule is not a mathematician. He is assisted by two of the mathematics teachers of the institution. These conferences are intended first of all to give the candidates opportunity to report upon the experiences in their instruction periods and to receive helps and hints from the seminar teachers. Furthermore, pedagogical-didactical questions are considered partly through lectures by the leaders of the seminar, partly through reports on the part of the candidates on pedagogical and elementary mathematics literature.

"So far as my own study is concerned I was in the Volkschule four years, then nine years in the Oberrealschule and finally have been attending the Technical High School and the University for four years.

"In order to give an idea of the arrangement of studies I append a list of my courses taken at the Technical High School. The numbers in parentheses give the hours per week of the lectures.

SEMESTER.		
1	Higher math. I (6) Exercises to this (3) Descriptive geometry (4) Exercises in same (4) Art history (5)	Trigonometry (3) Trigonometry exercises (1) Exp. physics (6)
2	Exp. physics (4) Descriptive geometry (4) Desc. geom. exercises (4) Physics lab. (4) Introduction to tech. mechanics (4)	Higher math. II (6) Higher math. exercises (3) Art history (5) Algebra (4) General chemistry (6)
3	Synthetic geom. (4) Elementary math. (foundations, etc.) (4) Exercises to this (1) Higher math. III (5) Exercises in same (2)	Money and banking (2) Money and banking exercises (1) Polit. economy (5) Theory of stability (4) Lab. exercises in this (1) Graph. statics (3)
4	Higher math. IV (2) Higher math. exercises (2) Dynamics (4) Exercises therein (1) Exercises in graph. statics (1)	Multiple integrals (3) Science of finance (4) History of political economy (4)

5	Diff. equations (4) Exercises therein (2) Theoret. physics (4)	History of pedagogy (2)
6	Diff. equations (3) Theoret. physics (4) Theory of pedagogy (2)	Differential geometry (3) Analytical mechanics (3)
7	Theoret. optics (4) Exercises in optics (2) Theory of functions (4) Exercises i.e., Th. of functions (2)	Photogrammetry (2) Exercises photogrammetry (1) Apparatus and methods of physics teaching in Mittelschulen (3)
8	Physical lab. (4) Theory of relativity (2) Line geometry (2)	Apparatus and methods of physics teaching in Mittelschu'en (3) Bacteria and fungi (2)

(The courses in "Higher Mathematics" are fully described in the catalogues of the Technical High School. They would compare with the courses given in Bailey and Woods' text, probably.)

I give next some observations from a German-American who had his training both in America and Germany, finishing last year in the University at Munich.

"What I state here was true in the years 1894-1904, and of course a few changes may have been made since these years. (This refers to north Germany.)

"The Gymnasium has twelve grades. The lowest is called the ninth, the highest the upper first. The ninth, eighth and seventh are the primary or preparatory grades. Here the pupil learns to read and write, arithmetic and mental calculations, natural history, local geography, biblical history, object lessons, drawing, singing, gymnastics, etc. In the sixth grade botany and German composition are added; in the fifth, history and zoölogy; in the fourth, French and plane geometry; in the lower third, Greek and algebra; in the upper third, physics; in the lower second, logarithms and trigonometry and chemistry; in the upper second, mineralogy replaces chemistry, anthropology replaces zoölogy and solid geometry the plane. In the lower first, analytical geometry and what is usually given in our college algebra courses are treated, and finally, in the upper first grade the mathematical training is topped off with an introduction to the calculus.

"The German idea is to start a new subject at the rate of five, yes, up to eight, lessons a week and then to reduce the number of hours from year to year, never dropping the subject entirely unless it be unimportant. Even botany was carried along for six years, mathematics for seven, Latin for nine. Are you surprised

that people know Latin, or mathematics, or French when they get through? One should note that plane geometry is taught before algebra and at twelve years of age; solid geometry at sixteen years.

"The pupil enters at six (without the preliminary attendance upon a Volkschule) and, if regularly promoted, graduates at eighteen, having then a fund of general knowledge which enables him to pursue any special study with all the advantages accruing from a general survey of all human knowledge."

Professor E. H. Taylor of the Charleston, Ill., Normal School, was studying certain phases of education in Germany last year. He gave me as his impressions:

"The Germans get better results than we do, I think, because, first and foremost, the teachers in the higher schools have better mathematical and professional preparation. You know that the preparation for the state examination is as strenuous as for the doctor's examination. After passing this examination the candidate must go through his Seminarjahr and his Probejahr. So long as we act as if we thought that any young person who has an A. B. degree and has penetrated into the mysteries of "higher mathematics" as far as trigonometry, and who has absolutely no training for teaching, is prepared to teach high school mathematics, we can hardly expect to compare favorably in our results with Germany.

"Besides this there is the somewhat longer school year, the better organization of the course in mathematics, as a result of which algebra and geometry are begun much earlier than is usual with us and are studied through a longer period of time, and the tremendous social and economic pressure which makes it a calamity for a boy to fail in his school work.

"So far as the final results are concerned, I think it is safe to say that the German boy who has finished a higher school where considerable attention is given to mathematics, is two years ahead of the American high school graduate so far as the work in mathematics is concerned."

The definiteness of aim in the German system of education impresses one. Consider, for example, the following statements of the purpose of the school taken from a catalogue of the Luitpold Oberrealschule in Munich:

"The nine-class Oberrealschule, like the humanistic and Realgymnasien, is an institution for general culture with the object of preparing for study in the higher educational institutions and of training to religious and moral efficiency.

"To those completing the course of the Oberrealschule, at present, the following (list of 26 named) branches of the public service are open.

"The six lower classes of the Oberrealschule, apart from preparing for the upper three classes, have the aim of training for the higher qualifications of citizenship on the basis of linguistic, mathematical-scientific and historical foundations, and for training in religious-moral efficiency.

"Accordingly, it is the main problem of the Realschule to give its scholars the most efficient possible preparation for life as a citizen, in so far as that life places higher demands upon the knowledge and the character of the man. The certificate of the six-class Realschule gives the right to enter the following (8 named) branches of the public service."

Of forty-three teachers in this school twenty were doctors of philosophy.

The final examination in mathematics involved finding the limit of $\frac{\sin A}{A}$ as A approaches zero; development of the derivatives for the trigonometric functions; discussion of the problem of the motion of a particle under a force varying as the distance from a center; development of a moment of inertia formula for a torus.

All is not perfection, however, even in Germany. I heard of troubles there much like we have here. Some found the teachers gruff and coarse and prejudiced and arbitrary. One mother told me how her son had had trouble with his teacher about the working of a problem and then had been mistreated and finally had gone over to America, out from the very shadow of Göttingen University, that he might have a chance to earn some money at the same time he was studying. The son of a man known to the entire mathematical world had just failed in school that year in Göttingen. Americans who had children in the public schools were not unanimously enthusiastic. I heard frequent complaints from those who thought the schools not up to ours. One evening I attended a large educational meeting addressed by a prominent educator from Berlin. He complained of the present school situation in his native land, that the people did not take the interest that they should take, that Germany, which is envied by all other lands for her youth, spends less for their education than

other European nations, that the public schools hold the lowest place in the public life, that the struggle about the public school will never be ended till the legend "National Property" is placed on every schoolhouse. In this connection he took occasion to describe in glowing terms how the Stars and Stripes wave over every school building in America. It is to be remembered that the above remarks refer almost solely to the primary and not to the secondary schools.

It is not necessary to draw any formal conclusions from such a rambling set of remarks. We are not unconscious of the weaknesses in our educational system in America. There is a spirit of inquiry and investigation, an openness to conviction and an earnest desire for improvement in all quarters. Note what is going on in our own state. Consider the report recently issued by a committee of the National Education Association on "The Economy of Time in Education." The completeness of this report and the radical reforms which it suggests for all parts of our educational system bear abundant testimony to the seriousness and freedom from prejudice with which we are considering education today.

The American boy is not slower than the German boy, nor is the American teacher potentially less competent than the German. Yet one cannot escape the feeling that better results in general are being accomplished in Germany today than in America. That need not and should not be true in a decade or two from now and we teachers should devote ourselves to the task of overcoming the reproach.

CHINESE REPUBLIC STUDIES OUR FOREST METHODS.

David Z. T. Yui, formerly secretary to the vice president of the Chinese Republic, is now traveling in this country to learn modern methods for adoption in China. He is at present in charge of the lecture board of the Chinese Y. M. C. A., which is in close touch with the new government and is aiding in putting into effect an educational campaign for the citizenship of the republic.

While in Washington recently, Mr. Yui spent some time investigating the work of the forest service, in order that he might find out whether its organization and methods would be of value to the newly created department of agriculture and forestry in China. In speaking of this part of his work, Mr. Yui said:

"In the matter of forest conservation the United States profited much by looking upon the disasters which were the result of the Chinese neglect of forestry. This was a great warning to you. Now we wish to profit by the improved methods of forestry which the United States has discovered and applied."

THE DERIVATION AND APPLICATIONS OF THE CONCHOID OF NICOMEDES AND THE CISSOID OF DIOCLES.

By Harry Roeser,
Washington, D. C.

Supplementary to algebra problem No. 392, proposed by the editor and published in the May issue of School Science and Mathematics, as follows: "Prove that the problem of the duplication of the cube is the same as that of finding two mean proportionals," the following translation from Cantor's *Vorlesungen über Geschichte der Mathematik,* Dritte Auflage, Band I, may be interesting. The translation is taken from the seventeenth chapter which is entitled "Die Epigonen der Grossen Mathematiker" and deals with some interesting problems and mathematicians after the time of Archimedes. The solution of the "two mean proportional" problem by two different methods invented by two different geometers is given. The geometers are Nicomedes and Diocles (both about 200 B. C.) who respectively invented the conchoid and cissoid to attain their solutions. The derivation of these two curves and their application to the solution of other time-honored classic problems of geometry is taken up. I have tried to follow the clear flowing style of Cantor and to give as nearly a literal translation as possible.

"The conchoid, or Muschellinie, of Nicomedes is the locus of a point whose right-lined connection with a given point is so cut by a given straight line that the sect between the intersection and the curve possesses a given length. According to the ratio of the distance of the given point from the given straight line and the conchoid the latter possesses three distinct forms; yet it is hardly possible that the Greeks knew of these forms, the most important differences of which lie in the branches of the curve that appear on the same side of the fixed cutting line as the given point. (See Fig. III.) To be sure it is hard to explain, in case this opinion passes as correct, what Pappus may have called the second, third, and fourth conchoids which might stand for other forms than the one used in the following discussion. As we know through Eutocius (6th century A. D.) and Pappus (about 3rd century A. D.), Nicomedes named the fixed point, the pole. He also discovered as both those authorities inform us, a device for drawing the conchoid which is easy to understand from the figure. (Fig. I.) It consists of three rulers joined together. Two of them are unit-

ed rigidly perpendicular to each other and while one is split almost its entire length by a groove the other carries a small round peg. The grooved ruler represents the fixed line; the peg upon the other represents the pole. The third ruler carries not far from the end of a peg similar to the pole and somewhat farther from the

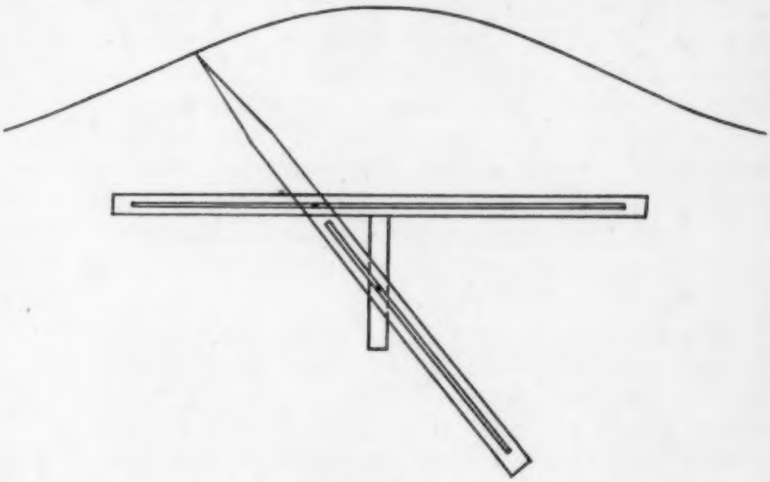


FIGURE 1.

peg a groove similar to the one upon the fixed line. The distance of the point of the third ruler from the peg represents the constant length. Evidently now must the point of this ruler describe a conchoid, if that ruler assumes all the positions of which it is capable, while its peg keeps in the groove of the fixed line and its groove engages the peg serving as pole.

Nicomedes has shown: (1) that the conchoid approaches nearer and nearer the fixed line; (2) that the conchoid must cut every straight line drawn between the fixed straight line and the conchoid; and (3)[*] that by means of the conchoid the problem of duplicating the cube can be solved. Let us follow here the processes of reasoning of his solution and demonstration.

The rectangle *cdef* (Fig. II) is formed from the sects $cf=2a$ and $cd=2b$ and *ed* is extended farther a distance $2a$ to *g*. At the midpoint, *k* of *de* the line *kl* is erected perpendicular and the end point *l* is determined by $el=dm=b$. This at the same time determines *gl* and the line *em* is drawn parallel to *gl* through *e*. This last is used as the fixed line, *l* as the pole, *b* as the given distance, and the conchoid corresponding constructed, which cuts the extension of *de* in *p* and which also makes $np=b$. If finally we

join p with f, extend pf to the intersection q with the line dc extended and call $cq=x$; $ep=y$, then is $2a:x=x:y=y:2b$ and the problem "To insert two mean proportionals between $2a$ and $2b$" is solved.

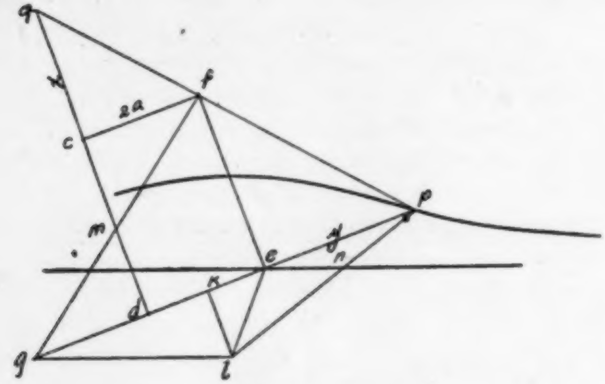


FIGURE 2.

From the triangles cfq and epf it follows that $\frac{x}{2a}=\frac{2b}{y}$ and $x=\frac{4ab}{y}=\frac{ge\cdot np}{e}$ From this it is seen that $nl=x$ and consequently $lp=x+b$. Now kl is a leg of two right-angled triangles, elk and plk. The first has $el=b$ as hypotenuse and $ek=a$ as second leg. Therefore is $b^2-a^2=(x+b)^2-(y+a)^2$, or $x(x+2b)=y(y+2a)$ or $\frac{x}{y}=\frac{y+2a}{x+2b}$. It is further noticed that the same fraction

$$\frac{y+2a}{x+2b}=\frac{dp}{dq}=\frac{ep}{ef}=\frac{y}{2b}$$

on account of the similarity of the two triangles dqp and efp. It is known therefore that $\frac{x}{y}=\frac{y}{2b}$, $2bx=y^2$. This equation subtracted from the previously found relation $x(x+2b)=y(y+2a)$, leaves $x^2=2ay$ for a remainder and the combining of the two equations $x^2=2ay$ and $y^2=2bx$ in the form of a proportion yields $2a:x=x:y=y:2b$. Solution and demonstration are equally good witnesses for the ingenuity of the inventor, who already, on account of the above mentioned method of drawing the conchoid, deserves an honored place in the history of mathematics.

This same conchoid has found application for the solution of another problem, namely the "trisection of any angle." If we give credence to the words of Pappus, he has given credit for that

application to himself. On the other hand, Proclus says explicitly that Nicomedes has, with the help of the conchoid, divided every angle in three equal parts and so we believe it proper to speak here of this application.

Archimedes traced the trisection of an angle down to the drawing of a straight line from a given point which shall cut a given circle and a given line, so that the sect between the two points of intersection shall be of given length. If we could replace the circle with another line, the problem would be only: "To draw a line from a given point through a given line on to a second line so that the segment between the two points of intersection turns out to be of a given length." This is accomplished by means of the conchoid, whose pole is the given point, whose fixed line is the first given line and whose constant distance is the given segment.

FIGURE 4.

Pappus has handed down to us some such substitution. (Fig. IV.) The angle *abc* is to be divided into three equal angles, *ac* is drawn perpendicular to *bc* and the rectangle *bcad* completed. The line *be* trisects now the given angle if the sect *ef*, between its intersections with *ac* and the extension of *da*, is twice as large as *ab*. For since *afe* is a right-angled triangle $fe=fg=ga$, if g is the midpoint of the hypotenuse, *fe*. Consequently there are present in the figure two isosceles triangles, *abg* and *age*. Since in addition *agb* is the external angle of the triangle *age* and *be* as transversal makes equal angles with the parallel lines, *de* and *bc*, then is angle $abe=$angle $agb=$angle $gea=gae=2gea=2ebc$, that is $ebc=\frac{abc}{3}$.

The actual trisection of an angle by means of the conchoid is not taken up by Cantor but it is readily accomplished as follows:

Let ABC (Figure 3) be the given angle. Lay off on BC, BM any convenient distance and let the line through M perpendicular to BA be the fixed line, or directrix, of the conchoid. Let the constant distance be 2BM and B be the pole. Construct the conchoid. Draw MN parallel to BA to the intersection with the conchoid. Draw BN. Then BN trisects the angle ABC. For, let K be the

intersection of BN with the directrix. Join M and L, the midpoint of KN. Then KN=OR=2BM=2LM (KL=ML since KMN is a right-angled triangle and L is the midpoint of the hypotenuse). The three angles marked θ are equal and the two marked ϕ are equal. But $\phi=2\theta$ since ϕ is the exterior angle of the triangle LMN, and $\phi+\theta=$ABC. Therefore the line BN trisects the angle ABC.

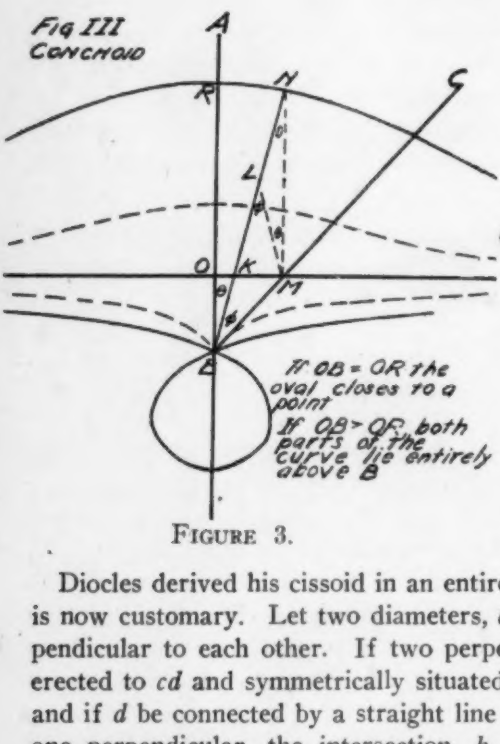


FIGURE 3.

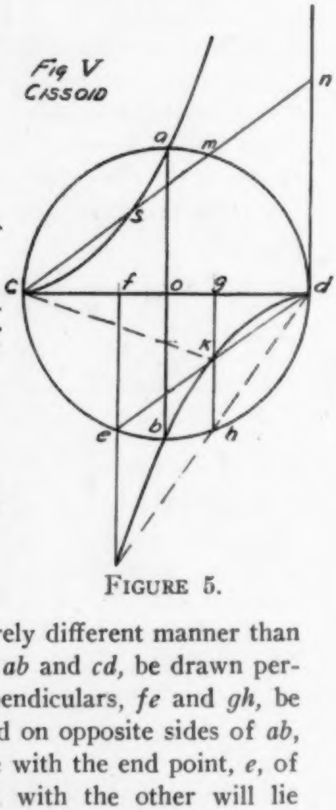


FIGURE 5.

Diocles derived his cissoid in an entirely different manner than is now customary. Let two diameters, *ab* and *cd*, be drawn perpendicular to each other. If two perpendiculars, *fe* and *gh*, be erected to *cd* and symmetrically situated on opposite sides of *ab*, and if *d* be connected by a straight line with the end point, *e*, of one perpendicular, the intersection, *k*, with the other will lie on the cissoid. As many points as necessary may be determined in this manner. At the same time we obtain the following proportion $cg:gh=gh:gd=gd:gk$.

The first part of this proportion is evident on inspection, because *gh* as perpendicular upon the diameter *cd* is a mean proportional between the two segments into which it divides the diameter. Again the triangles, *def* and *gdk*, are similar and therefore $fe:fd=gk:gd$. It follows that $cf:fe=gk:gd$, or by inversion, $fe:cf=gd:gk$. Finally, if we bear in mind that $fe=gh$ and $cf=gd$, the last proportion assumes the form $gh:gd=gd:gk$, and the asserted proportion which appears at the beginning of the demonstration is established; that is between *cg* and *gk*, which in the fig-

ure are drawn perpendicular to each other, gh and gd are determined as the two mean proportionals.

Now we can insert between any two sects, a and b, two mean proportionals. Draw at will any circle and the cissoid corresponding to it. Lay off from o on the vertical diameter, ab, the sect, op, as determined from the proportion, $cg:op=a:b$. To finish the problem it is only necessary to change the sects, gh and gd, which are mean proportionals between cg and gk in the ratio, $\frac{a}{cg}$; that is, determine x and y so that $x=\frac{a}{cg}\cdot gh$ and $y=\frac{a}{cg}\cdot gd$" .

The cissoid may be constructed by another method which is the one generally given in textbooks. Draw any circle (Fig. V). At one extremity, d, of the diameter, cd, erect a perpendicular. From c draw any chord, cm, and extend to meet the perpendicular in n. From c lay off on the chord, $cs=mn$, and the point, s, will lie on the cissoid. If cd be taken as the x-axis and the perpendicular through c as the y-axis the equation of the cissoid is $y^2(2a-x)=x^3$. The part of the curve lying in the fourth quadrant is not shown in the drawing. The curve may also be defined as the locus of the foot of a perpendicular let fall from the vertex of a parabola upon a tangent.

The problem of "duplicating the cube" is not taken up directly by Cantor. The solution depends upon that of "inserting two mean proportionals" as follows:

Insert two mean proportionals, x and y, between a and $2a$ $a:x=x:y=y:2a$.

Solving for x in terms of a by eliminating y from $x^2=ay$ and $y^2=2ax$, as obtained from the above proportion, there results $x=a\sqrt[3]{2}$, or $x^3=2a^3$. That is, x is the edge of a cube whose volume is twice that of the cube whose edge is a.

An interesting solution may be obtained in the following manner. Construct the curves $x^2=2ay$ and $y^2=\frac{ax}{2}$. The first is a parabola symmetrical with respect to the axis of Y, and passes through the origin. The second is a parabola symmetrical with respect to the axis of X, and passes through the origin. The abscissa of the point of intersection of the two curves (not the origin) will be the edge of a cube whose volume is $2a^3$, and the ordinate will be the edge of a cube whose volume is $\frac{a^3}{x}$. This may be proved by solving for x and y from the equations, $x^2=2ay$ and $y^2=\frac{ax}{2}$.

A VISIBLE FIRE-EXTINGUISHER.

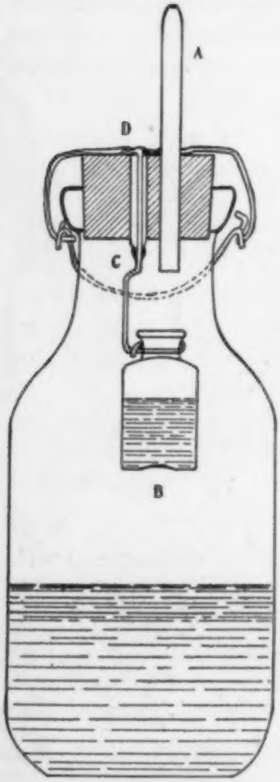
By Theodore Cohen,

Commercial High School, Brooklyn, N. Y.

The common fire-extinguisher is a very cumbersome piece of apparatus for purposes of class demonstration. Being made of metal the interior mechanism is concealed and the reaction that takes place between the chemicals when in use is invisible. The explanation of its construction and the principle upon which the extinguisher depends necessitates the taking apart of the apparatus, filling the tank, screwing back the top and thus rendering all once more invisible so that the pupil is forced to imagine what is going on inside. Aside from these disadvantages a great deal of time is thus wasted.

The diagram shows a simple fire-extinguisher for demonstration purposes which is designed to the end that the above disadvantages can be readily overcome.

An ordinary glass milk bottle (preferably one that has little advertising) serves as the tank. A small brown-colored bottle, (b), 30 cc. capacity, contains the acid. This bottle is held firmly in position by an aluminum wire (iron wire will serve the same purpose) about 2 mm. in diameter, one end of which is bent around the neck of the small bottle, (b), as shown while the other passes through a piece of glass tubing and is bent over the rubber stopper at (d). The glass tube before being inserted in the rubber stopper is drawn out at (c) and cemented there with sealing-wax. Sealing-wax is also applied at (d) to insure tight connections and prevent any liquid escaping from this point when the reaction takes place. The other hole of the rubber stopper is fitted with the delivery-tube, (a), of wide bore (about 8 mm.) and the upper end is drawn out to a bore of about 2-3 mm.



The metal cap of the milk bot-

tle is readily detached by applying heat to the soldered joints thus leaving the wire-clamp intact.

Since the walls of the milk bottle are fairly thick they are able to withstand a fair amount of pressure, but to insure against any possible mishaps preliminary experiments established the following formula which if carried out will cause no explosion when the reaction has begun and secures safety at all times.

Bottle (b)—1.0-1.5 cc. conc. H_2SO_4;
20 cc. cold water.

Milk bottle—15 gms. $NaHCO_3$;
200 cc. cold water.

When the solutions have been placed in their proper containers, the rubber stopper (carrying with it at all times the attached mechanism) is firmly inserted in the neck of the milk bottle and the wire clamp securely locked over the stopper, as shown. The milk bottle is then inverted when a forceful stream of liquid will be shot through (a). This liquid may be allowed to play upon a small fire.

This apparatus has been working here successfully. The whole operation from the time of filling the extinguisher to the end of the reaction (all of which is always visible to the pupil) takes but a few minutes and serves to bring out all important points covered by the commercial extinguisher.

MOUNTAINS OF CULM DISAPPEARING.

The mountains of culm or coal waste which break the sky line throughout the anthracite coal region of Pennsylvania and which were for many years considered a nuisance are now being made to serve a very useful purpose. There is at present a market for almost any grade of anthracite that will burn, and no more coal goes to the culm bank except for temporary storage and subsequent recovery by washers. These ranges of artificial hills, unsightly monuments to former waste, are contributing their share to the total coal production and are rapidly disappearing. Even the waste from the culm-bank washers is being utilized, for it is flushed into the mines and partly fills old workings where it cements together and furnishes support to the roof when the coal previously left for pillars is removed.

The tungsten resources of the United States are probably considerably larger than have been generally realized. Many new deposits have been discovered in various parts of the Western States, according to the United States Geological Survey, and, should prices advance, it is probable that the output could soon be increased much above the record year of 1910, when 1,821 tons were marketed. Most of these new discoveries are not sufficiently developed to show how large an output can be expected from them; but it is probable that some will prove to be of considerable extent, and one or two new large producers would make a noticeable difference in the American market. Similar discoveries may also be expected in other parts of the world.

WHAT MODERN HIGH SCHOOLS ARE PLANNING IN HOME ECONOMICS CURRICULA. II.[1]

By Lucile W. Reynolds.
Madison, Wis.

The Course in Sewing in the Madison, Wis., High School.

Domestic science or home economics is a part of the Manual Arts course recently established in the Madison High School. At present three years of work are offered. We hope next year to extend the course to four years. No pre-requisites are required for the first and second year courses and the work is elective for all students. We coöperate with the Art Department in the first and third year work. Each student who elects freshman sewing is required to take domestic art as well, or ten periods a week in both, and for this she receives one credit for the year. (In the Madison High School sixteen credits are required for graduation.) In the second year, students may elect cooking and food work ten periods a week, one credit for the year. The third year work is offered this year for the first time. Here there is a choice of two courses. For the first, sophomore cooking and food work is a pre-requisite, for the second, freshman sewing and domestic art. Following are the courses:

1. House Management—Semester 1.
   House Decoration—Semester 2 (Art Department).
2. Costume Design—Semester 1 (Art Department).
   Advanced Dressmaking—Semester 2.

Here again one credit is given for each course.

Of the courses offered during the three years, the work in freshman sewing and domestic art attracts the largest numbers. The majority of our pupils come to us from our city ward schools so they have had hand sewing in the fifth and sixth grades. The aim of the work in first year sewing may be summed up as follows:

To develop in the pupil—

1. Right standards in regard to the selection of clothing.
2. Intelligent standards in workmanship.
3. Practical knowledge of standard fabrics used in manufacture of clothing.
4. Development of aesthetic sense in selection of fabrics.

[1] No. I appeared in October number of School Science and Mathematics.

Our aim, then, is not alone to make a practical seamstress of the girl, but to broaden her knowledge of and interest in the educational aspects of clothing. Hand in hand with the work in garment-making a study is made of the fibers, the method of manufacture of the different fabrics, their comparative values, and their fitness in the wardrobe. Gibb's *Household Textiles is* used as a reference (there are 20 copies in the library), also Kinne and Cooley's *Shelter and Clothing*. A note book is kept by each pupil and the facts developed in recitation are recorded and samples of typical fabrics are mounted.

The practical work accomplished in the freshman year includes the making of a simple suit of underwear, a cooking apron, a gingham or linen dress, and, if time permits, a thin wash dress of organdy or lawn. Patterns adapted to the pupil's measure are selected by the pupil under the guidance of the instructor. We do no drafting in our freshman work. This year we are introducing the making of the kimono nightgown first, then, following this, the corset cover, drawers, petticoat, then the apron (to be used later in sophomore cooking), and the dresses.

We insist on careful machine work and a limited amount of handwork on each garment, but we *do not* encourage the making of long seams by hand. One or two lessons are given on the operation and the care of a sewing machine.

Last year we coöperated with the Art Department in the working out of a Christmas problem. A conventionalized Nature design was made in the art classes, and in the sewing classes this design was transferred to linen crash and was worked out in colors. This problem was utilized as a library table cover or a sofa pillow.

There is much uniformity in the underwear made but variety is secured in the different kinds of trimming used. This gives us an excellent opportunity to make a study of laces and embroideries, the method of manufacture and the comparative cost.

Prior to the making of the dresses in Freshman Sewing a study of costume design is given in the domestic art course. Individual figures are studied and this is followed by a discussion of suitable styles for different figures. Samples of dress fabrics are selected and a study is made of the different patterns. Then each pupil designs her own dress to suit her figure and complexion. She brings this design to the sewing class and selects a pattern that corresponds to the one she has designed. We emphasize here the beauty of simplicity in wash dresses. Each girl keeps an accurate record

of the expense entailed in the making of the dress and the totals are compared and conclusions are drawn. This forms an excellent opportunity for the sewing teacher to emphasize the economic aspect of the dress question.

The course in advanced dressmaking is, as before stated, for those students who have had the first year work in sewing and domestic art and one semester's work in costume design. The work as now planned includes the making of a wool or silk, or wool *and* silk dress, the renovating of an old dress and the designing and making of a party dress. Ten periods or five eighty minute periods a week are devoted to this work.

Our course in sewing is yet in the making, but we hope, with the coöperation of the Art Department, to make this a very strong feature of the domestic science work in the Madison High School.

JUDGING THE KITCHEN.

By Thos. E. French,
Ohio State University.

In the course in "House Planning" given to the students in Home Economics at the Ohio State University, the functions of the different rooms of the house are studied scientifically, with the view of designing them so that they may fulfill their purpose in the best way possible. In this study the first room to be taken up is the kitchen, whose design has for so long been haphazard, but to which the principles of modern "efficiency engineering" may be applied so effectively as to increase enormously its convenience and comfort, if the same thought be given to its details that is given to the design of any other manufacturing plant.

After a lecture on the kitchen and its accessories, each student is given a blank score card on which is to be scored the kitchen of the house in which she is living, the object, of course, being to emphasize the lecture and to train in the power of careful observation. Following this, they are given a number of problems in designing and remodeling.

It has been suggested that the score card used may be of interest to the readers of this department. The original idea of such a card comes from Professor Benjamin R. Andrews, whose work with Professor Commons in the study of houses and housing is well known.

In this method of judging, the ideal kitchen would score 100 points, and cuts are made under each of the four heads for any items failing to reach the standard indicated. Some of these depend on actual measurements, while others are matters of judgment.

The class shows great interest in filling these scores, and under the head of "suggestions" will make very full comment. When the kitchen scored is an old one, they will often remodel it entirely.

KITCHEN AT ....

SCORED BY ....

	Total.	Cut.	Score.
I. *Plan*—35 Points.			
1—Arrangement of space for equipment........ Sink—convenience of; Stove—convenience of; Table—convenience of.	15		
2—Storage .... Stores Pantry, size, convenience; Serving Pantry, convenience; Refrigerator, convenience; Shelving, adequate; Clock Shelf. Distances—If any two (sink, table, stove, pantry) are farther apart than 12 ft., cut ½ pt. for each ft.	15		
3—Doors .... If more than 4, cut 1 point for each. Outside door direct to covered porch, if no covered porch, cut. Door to Dining Room double swung if direct. Accessibility to front door. Accessibility to upstairs. Accessibility to cellar. If rear stairs go up from Kitchen, cut 3 pts.	5		
II. *Light and Ventilation*.......................... Two exposures; if only one cut 5 points. Glass area= 20% of floor area, cut 1 point for each 1% under. Window in Pantry, cut 2 pts. if none. Satisfactory daylight—at stove, at sink, at table, 3 points each. Satisfactory artificial light—at stove, at sink, at table, 3 points each. Transom on outside door, 1 point. Height of sills—If under 34" cut 1 point. Ventilating hood or flue—1 point.	25		
III. *Floors and Walls*—10 Points.			
1—Floor Resilient and grease proof............. Hardwood, Monolith or Linoleum, O. K. Cut for cracks, softwood, oil cloth, carpet, etc.	4		
2—Walls .... Light, cheerful, sanitary. Cut for wall paper or dark color.	4		
3—Woodwork .... Cut for dust catching mouldings or projections—1 point. Cut for wood wainscot—1 point.	2		

IV. *Equipment*—30 points.			
1—Stove—adequate size and condition	12		
If oven is less than 10″ from floor cut 1 pt. per inch.			
If no broiler, cut 2 points.			
If no thermometer, cut 1 point.			
2—Sink	8		
Enamel or Porcelain O. K.			
Cut for iron, tin, etc. 3 points.	2		
Drainboard double, cut 3 points if single.			
Splashboard, cut 2 points if wood.			
3—Table	3		
Size—cut 1 pt. if smaller than 6 sq. ft.			
Height—cut 1 pt. if uncomfortable.			
4—Refrigerator	5		
Size, material, condition, drainage.			
5—Chair and stool			
Total	100		

If no water in Kitchen, cut 40 points.
If no hot water in Kitchen, cut 20 points.
If Kitchen is used as Laundry, cut 15 points.

REMARKS.

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SUGGESTIONS FOR IMPROVEMENT.

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For the manufacture of pottery of the better grades considerable clay, mainly kaolin, is imported into this country from Europe and China, the value of these imports last year exceeding $2,250,000. It seems probable that under the necessity due to the war of now finding a domestic supply these finer clays can be in large part replaced. Already a process of decoloring kaolin is reported as successful, and this may make large deposits of kaolin and ball clay available for the manufacture of white ware and pottery.—*Bulletin 599, U. S. Geological Survey.*

THE COMMON TOWEL.

This household infection spreader is abhorrent and repulsive to a person who has been used to an individual towel. It is difficult to understand how any one can wipe his face on a soiled, damp towel that has been used by all the other members of the household. But custom is a great factor in molding habits and allaying prejudices, hence the necessity of pointing out at least one reason why the common towel is dangerous. There are many germs which will attack the eyes and cause inflammation, providing the eyes are in a favorable condition for the germ to develop at the time of its introduction. A germ which at one time will grow in the eye and cause inflammation will at another time be perfectly harmless. Germs which are harmless to oneself may be exceedingly poisonous to another person and cause dangerous inflammation of the eyes. For hygienic reasons the common towel should be abolished in every home.

REPORT OF COMMITTEE ON STATE OF PHYSICS TEACHING IN INDIANA HIGH SCHOOLS.

The committee find that although conditions affecting the teaching of physics are as a whole improving in this state, yet it is obvious that much progress must be made if the subject is to take its proper place in the high school course of study. We have considered the situation not only from the standpoint of the teacher but of the community as well and herewith suggest some of the needs and phases of the subject as developed by our inquiry:

I. *Physics deserves and merits a large place in the school curriculum because:*

- (a) It has an intimate bearing upon all phases of our everyday life.
- (b) Its achievements have made the whole world into one great community.
- (c) It enters into all the operations of every convenience of modern life.
- (d) It is the open door to all progress in engineering.
- (e) It is not only nature study but, besides, teaches the philosophy of the action of natural forces and thereby gives us not only ability to control them, but also gives us a true perspective of the natural sequence of things.

II. *Some essentials of good physics teaching:*

- (a) A well prepared teacher. The standard should be kept very high, and to that end the examination requirements should be raised.
- (b) Reasonably good equipment.
- (c) Adequate time should be given not only for laboratory work but for the class room as well. Five double periods per week should be allowed for the course in physics.
- (d) The time devoted to particular topics should be properly proportioned so that no time may be wasted on obsolete matter.
- (e) The intimate relations of physics to daily life should be kept constantly in mind.
- (f) It should involve live problems.
- (g) It should provide opportunity for independent observation and reasoning on the part of each pupil.
- (h) Amusement features of spectacular experiments should be conspicuous by their absence.
- (i) The entire course should have a more or less definite conformity to local industrial conditions.

III. *Sequence of the science in the high school:*

- (a) Present arrangement not a true logical development, due to the fact that high school subjects have been pushed into the high school from "above" by the college.
- (b) The tendency throughout the central states is to place botany, physiology, and zoölogy in the first two years and chemistry and physics in the last two years of the high school course.
- (c) The prevailing order is due in considerable extent to conformity to the muscular development of the child, the cruder work of the lower grades not requiring extreme care

[1] Presented to the Physics and Chemistry Section of the Indiana Association of Science and Mathematics Teachers, March 6 and 7, 1914.

and accurate adjustment of apparatus is easily performed by the child of immature muscular development. The more accurate quantitative work of physics and chemistry is better adapted to the more mature development, both physically and mentally, of the child in the higher grades. If a higher grade of work is to be done in physics and a broad appreciation of its essential principles obtained, a considerable amount of mathematical work is absolutely indispensable as a prerequisite study. Under existing conditions, with physics presented both as a college entrance requirement and as a basis for life work of the student it is best placed in the last years of the high school course.

IV. *Should a general science course be given in the high school?*

(a) The need of such a course is dependent upon the nature of the natural science courses given in the first two years of the high school; if these courses are adequate and well presented there will be little need of a general science course.

(b) If such a course is given it should include simple exercises involving the fundamental principles of each of the sciences as now presented in the secondary schools. These exercises should have an intimate relation to the phenomena common to the daily life of the student and should serve as a broad basis for the later and more intensive study of the individual sciences.

(c) Some general descriptive science course could be given with profit in the grades just below the high school but great care should be exercised in such work to prevent it from degenerating into mere "busy work."

(d) We note a considerable tendency to arrange a general science course for the high school which may be divided into first year, second year, third year and fourth year science instead of dividing on the present lines of distinct subjects, as botany, chemistry, physics, etc. We can see that economy of time and material would be gained by this arrangement, but accompanied, no doubt, by a corresponding loss in historical development and "subject enthusiasm." At the present time the content of our science courses is so vaguely defined that it is doubtful if the time is fully ripe for such a change. It is evident, however, that progress is being made in this direction and the next decade will undoubtedly witness a rearrangement of the science courses to conform to the inevitable demand of economy of presentation and logical development of our scientific knowledge.

V. *Should there be a fixed syllabus for Indiana schools?*

(a) The general consensus of opinion is opposed to a rigid syllabus, feeling that such a fixed requirement would impose too great a burden upon many schools throughout the state. In some sections of the east the fixed requirements have become very burdensome and the initiative power of many otherwise excellent schools, destroyed.

(b) We favor a recognized framework however, acceptable to both the colleges and high schools. This outline should be based more upon the community needs of the high school than upon entrance requirements of the college. The fundamental principles of each phase of the subject should be

included and should form the minimum; upon this as a basis more extensive work may be added as equipment and time of the individual school will permit. The minimum requirements of the college can be fully met, however, and the "community needs" fully satisfied in the same course if due care is exercised in planning the work.

VI. *Segregation of boys and girls.*

(a) At present time accurate data is so limited that a positive conclusion is not justified, but we suggest that segregation be practiced when conditions warrant it, if it is considered desirable to make extreme distinctions in content of subject matter given to boys and girls in any given school. When a rigid course in mechanics and pre-engineering work is desired, a separate course for girls can well be given that will include the fundamentals of physics but placing the emphasis on its application to "household physics." In no case, however, should the fundamentals of science be sacrificed merely to develop an "easy course," for a science course that is merely "easy" is usually devoid of scientific value.

VII. *"Vocational" physics.*

(a) In no case should this take the place of the regular course.
(b) It should be based upon and supplement the regular course.
(c) It should only be given then in case adequate time and equipment are available.
(d) It should be based to a certain extent upon local industrial applications of the science.
(e) It should as far as possible include close coöperation between school and shop; should include visits to local plants, and lectures by competent men on the application involved.

VIII. *Credit given by college for high school work.*

(a) At present most colleges in this state allow students not having had high school courses in physics or chemistry to enter college courses in these subjects on an equal basis with those who have. It is evident that the student's degree of mental maturity is counted a greater factor than his previous training in these specific subjects. We feel, as a committee, however, that greater economy of the student's time will be secured if there is less "overlapping" of subject matter and more logical relation between the preparatory courses in physics and chemistry and the college courses in the same subjects. In case of exceptionally strong students who have thoroughly completed advanced work in the high school, proper recognition should be made by the college in the form of advanced or extra credit. The whole subject of college entrance credit requirements has been the subject of careful inquiry on the part of Prof. Morrison of Earlham College, a member of this committee, and is included as a part of this report.

Prof. Morrison's Report on College Entrance Requirements.

In order to obtain a view of high school physics from the college viewpoint the following list of questions was sent to the teachers of physics in ten colleges and universities of the state of Indiana.

1st. If a student upon entering your institution has more than the required units for college entrance, and such units are in science, is he allowed college credit, in whole or in part, for such excess work?

2nd. Do you admit students to your freshman or beginning classes in physics who have not had physics in high school?

3rd. If you do not admit students to your classes who have failed to take physics in the high school do you conduct preparatory courses in the subject?

4th. If you admit students to your beginning courses who have not had high school training in the same subject can you determine the fact by the grades receives by such students?—. Can you determine the fact by the increased ability of those who have had high school training to carry your course?

5th. Do you believe that efforts should be made in the Indiana high schools to coördinate high school physics with that of college physics?

6th. Should the emphasis in high school physics be upon preparation for college physics?—. If not upon what should it be?

7th. Remarks—.

A similar list of questions was sent to the teachers of chemistry in the same ten institutions. The following is a summary of answers to the questions.

	Questions	No. 1	No 2	No. 3	No. 4	No. 5	No. 6
	No.	2	2	6	5	6	7
Physics.	Yes	5	6	2	3	2	1
	No answer.	3	2	2	2	2	2
	No	3	1	8	5	5	5
Chemistry.	Yes	4	8	1	2	3	4
	No answer.	3	1	1	3	2	1

We may clearly gather the following by reviewing the answers to the questions and the remarks which accompany them:

1st. That no college credit should be given for excess units in high school physics and chemistry, except in case the units are for post graduate high school work.

2nd. That students are admitted to college classes in physics and chemistry upon the same basis whether they have or have not had high school training in these subjects. Also that with slight exceptions there is but little difference between the ability of those who have and those who have not had high school training to carry the college subjects.

3rd. There is almost a unanimous opinion that no special effort should be made to coördinate high school and college physics and chemistry. The high school should map out its work to best fit its students for life's work instead of fitting them to successfully pursue certain college courses. If the high school student can be trained to "think" and to think accurately he will be best equipped to go out into the work of life or to college as the case may be.

James E. Weyant,
Shortridge High School, Indianapolis.
Edwin Morrison,
Earlham College.
Earl R. Glenn,
Froebel School, Gary.

SOME COMPARISONS OF COURSES IN BIOLOGY AND PHYSICAL GEOGRAPHY IN THE HIGH SCHOOLS OF FORTY-TWO CITIES.

BY LUCIE HARMON AND ALICE GRAPER,
West Division High School, Milwaukee, Wis.

The material for this article was gathered by the authors last January at the request of the Milwaukee Association of Biology Teachers who, when confronted with problems arising from a proposed change in their own course of study, found themselves ignorant of conditions in other cities.

To the fifty-three sets of questions sent to superintendents, forty-two replies were received. The list of questions was as follows:

Is physiology taught in your high schools?
If so, how many weeks long is the course?
How many periods per week?
Is it a required study?
How much time per week is given to laboratory work?
How much time per week is given to recitations?
In which of the four years is the subject taught?

The same questions were repeated for botany, zoölogy, biology, and physiology.

From these the following results were obtained.

Physiology or hygiene is taught as a separate study in thirty of the forty-two cities, botany in thirty-eight, zoölogy in twenty-nine, biology in fourteen, and physical geography in thirty-seven. Only three cities, Duluth, Houston, and Nashville, give biology with no separate courses in botany and zoölogy.

Two cities, St. Joseph, Mo. and Rochester, give all of the five studies mentioned, twenty-five cities give four, the others, three or less.

Only one year of biology science (under this term we include any course in botany, zoölogy or physiology) is given in the following eight cities: Cleveland, Duluth, Ft. Wayne, Houston, Minneapolis, Nashville, Richmond and St. Paul.

Six cities, Kansas City, Memphis, Milwaukee, Newark, New Orleans, and Omaha, give a year and a half of biological science.

Five cities, Buffalo, Denver, East Orange, St. Louis and Toledo, give two years.

Nine cities, Baltimore, Detroit, Evanston, Indianapolis, Louisville, Newton, Oak Park, St. Joseph, and Seattle, give two and one half years.

Twelve cities, Boston, Cincinnati, Grand Rapids, Los Angeles, New Haven, New York, Philadelphia, Pittsburg, Salt Lake City, San Francisco, Tacoma, and Worcester give three years.

Chicago and Rochester lead with courses amounting to three and one half years of biological science.

Of the thirty-seven cities offering physical geography, twenty-five devote a whole year to the course and twelve a half year.

In most schools where botany, zoölogy, and biology are studied an equal amount of time is allotted to each.

Three cities allow less than five periods per week for a given biological study, twenty-one cities give five periods, two give six, eleven give seven, four give ten. Those giving more than five periods per week give in most cases one or more double laboratory periods.

To physical geography five cities give less than five periods per week, twenty-two give five, two give six, five give seven, and one gives ten.

Physiology is required of every pupil in the high schools of nine cities, botany in three, biology in five, and physical geography in five. In most places these subjects are required only in certain courses.

In twenty-four cities physiology laboratory is given, varying from one to five periods per week. Six cities give none. In no instance is botany, zoölogy or biology given without laboratory. Thirty-one cities give laboratory work in physical geography. Six give none, but these are not the same six which fail to give laboratory work in physiology.

Physiology is taught in the first year in thirteen cities, in the second in four, in the third in two, in the fourth in three. In nine the year varies.

Botany is taught in the first year in five cities, in the second in twelve, in the third in two, in the fourth in two. In seventeen the year varies.

Zoölogy is taught in the first year in two cities, in the second in ten, in the third in four, in the fourth in one. In twelve the year varies.

Biology is taught in the first year in three cities, in the second in six, in the third in one, in the fourth in none. In three the year varies.

Physical geography is taught in the first year in seventeen cities, in the second in seven, in the third in two, in the fourth in five. In six the year varies.

We wish to thank those who so kindly assisted us by answering our questions. We submit our results to them and to other fellow-teachers who may be contemplating changes in their courses of study or who are merely curious to determine their own positions in the general line-up.

PLANTS AND SEEDS IN THE CLASS ROOM.

Practical Instructions for Collecting and Preserving Illustrative Agricultural Material Issued by Government.

Information that will be welcomed by teachers who wish to have agricultural material for object lessons, has recently been collected and published by the United States Department of Agriculture. The department's investigators have devoted their attention not so much to collections for museums as to material for use in illustrating instruction given in class rooms, and in Farmers' Bulletin 586, "Collection and Preservation of Plant Material for Use in the Study of Agriculture," they have set down many hints and suggestions for facilitating this work.

The illustrative material, the authors of the bulletin point out, is not only useful in itself, but competent teachers can make its collection of the greatest value. The work should always be constructive, never destructive, and no indiscriminate picking or digging of wild flowers should be allowed. Every specimen should be properly and fully labeled, with all the necessary data, at the time it is collected.

Material for use in agricultural classes, it is obvious, should not be regarded from a purely botanical standpoint. In practice it will generally be found that such a collection will fall into two main classes: (1) plants of value to the farmer, and, (2) noxious plants or weeds. In the second class special attention should be given to poisonous plants in order to familiarize students with their appearance.

In collecting the plants, a tin botanical specimen case should be used if possible, but if this is not easily obtainable any sort of covered box large enough for plants to be placed in without crushing will prove quite satisfactory. It is important, however, that the box have a cover, for the specimens should remain moist until they can be prepared for pressing.

Care should also be taken to identify the plant in the field and to attach to it its proper label without delay. This label should remain constantly attached to the specimen until it is finally mounted in permanent form.

Before mounting, most of the specimens will have to be pressed. Various methods for doing this are familiar to all teachers of botany or agriculture. Perhaps the simplest method is to place the plants between two layers of blotting paper on top of which is a flat board bearing a heavy weight. The authors of the bulletin suggest substituting for this blotting paper sheets cut from felt paper such as that placed beneath carpets. If this is done the paper should be changed twice each day for the first two days and once each day for the week thereafter.

Under ordinary circumstances pressed specimens are best kept in what are known as herbarium books. These may be obtained in various sizes from school supply houses. The sheet in most common use by botanists is 11½x16½ inches in size. The specimen is either glued to the sheet or fastened to it by either gummed cloth or paper. The mounted specimens are then grouped according to their genus, each genus being enclosed in a separate cover of strong manila paper.

This plan of course is not satisfactory when it is desired to have the specimens constantly displayed. In such cases a box with a glass cover and a loose back has been found better. The specimen is mounted on cotton and the loose back fastened down so tightly that cotton and specimen are held against the glass. Glass-covered mounting boxes of this character are usually made from heavy cardboard and can be purchased from supply houses, or made by exercising a little ingenuity at home. In mounting, place the object upon the glass, face down. Layers of cotton batting should then be placed upon it until the box is completely filled, when the back is put on and fastened down. This method should also be used for mounting objects which it is not possible to press, such, for instance, as heads of grain.

Again there are some specimens which cannot be satisfactorily dried. Among these may be mentioned fleshy fruits or roots of leguminous plants. It is advisable to have these mounted in glass jars filled with some sort of preserving fluid, an ordinary fruit jar being quite satisfactory in most cases. In dealing with specimens of this character, however, care must be taken to avoid excessive drying or bruising while in the field. To make sure of this each specimen should be separately wrapped in a moist newspaper as soon as it is gathered. All roots and similar articles should be carefully washed before being placed in the jars. They should moreover be kept in a 2 or 3 per cent solution of formalin—the formalin having the strength of 40 per cent formaldehyde—for several days before being placed in the preserving jar, where a 5 per cent solution of formalin should be used.

A collection similar to that of plant specimens can be made of the seeds of plants. In particular this should include the seeds of local weeds in order that the students may familiarize themselves with the appearance of these and readily distinguish them from other farm seeds. A careful study of this kind will be beneficial in aiding in the detection of adulterations and impurities in commercial seeds.

In collecting the seeds from the field, care should be taken to write all the necessary data, such as the date, locality, name of the plant, etc., upon pieces of paper and place the paper at the same time as the seed in a cloth bag or paper envelope. The seeds should also be carefully cleaned of all impurities and treated with carbon bisulphide or with formaldehyde before they are placed in their final receptacles. This is necessary in order to kill any injurious parasites which may have fastened themselves upon

them. A piece of cotton placed on a saucer and thoroughly saturated with carbon bisulphide or formaldehyde is put in a closed receptacle with the seed and left there until the fumes have done their work of disinfection.

There are a large number of convenient and simple ways of caring for the seeds after this. A favorite method is to place the seeds in small glass vials which are placed in a strong cardboard box with a seperate compartment for each vial. Screw tops for the vials are better than the ordinary cork since they protect the seeds from insects. If larger quantities of seeds are desired, glass bottles or jars can be substituted for the small vial.

For the purpose of study, however, it is frequently very important that the sample should be thoroughly visible without handling, and this can be accomplished much better by mounting under glass than by keeping in either jars or vials. A convenient mounting rack can be made from a pane of clear glass, about 10x12 inches in size and two pieces of half-inch board, a trifle larger than the glass. One of these boards should be ruled off in squares about 1½ inches each way. At the intersections of the boundary lines, a one-inch hole should be bored. When the board is glued to the other one, each of these holes will form a pocket in which a sample of seed or grain may be placed with its label pasted underneath. The pane of glass should now be put on as a cover for all the pockets. The glass can be held tightly over the pockets by placing the whole mount in an ordinary picture frame and fastening it with small nails; or sheets of heavy cardboard may be substituted for the pieces of board and the cardboard and glass held together by binding the edges with gummed paper. Small sized mounts of this character may be easily handed about in the class room and the seeds may be examined conveniently under a microscope.

Plants and seeds that are mounted in ways similar to those which have been described are not likely to suffer greatly from moths or insects, but in order to be on the safe side it is well to sprinkle moth balls in the vicinity, or in case of jars that are open, to drop one or two in each one.

A third collection which is often of considerable assistance to the teacher is that of wood specimens. The autumn is the best time to collect these, when the fruit is more or less mature and when the leaves have not yet fallen, for the leaves and fruit are often important in determining the identity of a tree. The collector should be careful to take a characteristic specimen of the tree, for it must be remembered, for example, that the barks of a young tree and an old one of the same species are often very different. Again, a young tree should not be destroyed in order to obtain a section of its trunk but a branch from a larger and older one taken instead.

The rough blocks of wood should be labeled as soon as taken and then put away until thoroughly dried. When the wood is properly seasoned it may be finished in any shape that is convenient. It is desirable, however, that a flat surface at right angles to the radius should be made in order that the grain of the wood may be shown. Linseed oil will help prevent the specimens from cracking and will also bring out the grain and color of the wood more clearly.

Still another collection which teachers of agriculture will find beneficial can be made of the two important groups of fungi. The first of these consists of the parasites which feed upon living plants; examples of these are the rusts, smuts and mildews. The second group live upon dead or decaying organic matter and are frequently beneficial to other plants.

Among them are included mushrooms, toadstools, and the woody "brackets" that grow on the sides of decaying logs. In the case of the "brackets" it is well to secure with the specimen a section of the wood to which it is attached in order to show the relationship of the two. Some of these fungi, in particular the moist and fleshy ones, are very difficult to preserve since they break down in a very few hours into a jelly-like substance. These should be preserved in liquids and kept in closed jars or bottles. A good formula for the preserving solution is alcohol, 1 part; formalin, 1 part; distilled water, 15 to 20 parts.

The rusts, smuts and mildews which afflict grain, and which, therefore, it is very important that the student should be familiar with, can best be mounted by collecting samples of the plant on which they are fastened. These specimens should then be mounted in a glass-covered box in cotton in the manner already described. These hints will be readily supplemented by the experience of agricultural teachers. The important thing is to have the specimens so preserved that they will be readily accessible to the student.

The recently published bulletin "Collection and Preservation of Plant Material for Use in the Study of Agriculture," which will be sent on request free of charge, describes a number of the most satisfactory methods of accomplishing this. Others will readily suggest themselves to everyone.

LIVE CHEMISTRY.

By R. E. Bowman,
Alliance, Ohio.

Chrome Tanning of Leather.

Several boys were asked to bring pieces of rawhide to school. Having done this, they were referred to Thorpe's *Industrial Chemistry*, pages 540-541. They then calculated the strength of their baths, and in two or three periods had prepared passable chrome leather. Samples of the tanned and untanned leather were mounted in the note books. The rawhide was "worked in a solution of $K_2Cr_2O_7$ to which some common salt had been added, together with one-fourth to three-fourths of the theoretical amount of HCl necessary to liberate all the CrO_3. After several hours, when the skin showed a uniform yellow color, it was removed, the excess water pressed out, and the skin worked in a bath of $NaHSO_3$ to which some HCl had been added to liberate the SO_2.

"1. $K_2Cr_2O_7+2HCl = 2KCl+H_2O+2CrO_3$.

"2. $Na_2S_2O_3+2HCl = 2NaCl+H_2O+S+SO_2$.

"3. $2CrO_3+3SO_2+3H_2O = 3H_2SO_4+Cr_2O_3$."

Leather watch fobs made in this way are treasured keepsakes in later years.

CO_2 and Carbonates.

A valuable series of tests may be made upon baking powders, limestones, and washing powders, by the use of the Schroetter or some simpler acidimeter. The very delicacy of the apparatus makes even a careless pupil cautious, and in three years we have not had one broken. Only three weighings are necessary. The results may be tabulated as follows:

1. App., HCl and sample (dry)	———	———
2. App and HCl..................................	———	
3. App., HCl and sample—CO_2..................		———
4. Wt. sample....................................	———	
5. Wt. CO_2.....................................		———

From the weight of CO_2 found, the per cent of $NaHCO_3$ in baking powder, $CaCO_3$ in limestone, or Na_2CO_3 in washing powder may be calculated.

$$\frac{CaCO_3}{CO_2} \times \frac{\text{wt. } CO_2}{\text{wt. sample}} \times 100 = \%CaCO_3 \text{ in limestone.}$$

Here an error is necessarily introduced owing to the presence of more or less $MgCO_3$.

Destructive Distillation.

A cast iron retort 24" long, 4" in diameter, having a mechanical flange and cover, is ideal for this experiment. One charge of wood, coal, or bones will last two to six hours. Pack the wood or bones in tightly, but fill only half full of coal fragments no larger than a walnut, to allow for the expansion of the coke. After charging the retort, make a paste of asbestos plaster or asbestos and plaster parts. Spread this paste about the flange and clamp down the cover of the retort while the paste is still soft. The joint will be nearly gas-tight. The cover should have a 1" gas pipe about 15" long, screwed into it. The sheet iron retort, listed as ★ 4522 in the Eimer and Amend catalogue, serves very well, but is not absolutely gas-tight. If a temporary brick furnace can be built about the retort, a large saving of gas is made in heating the charge. The furnace should be well insulated by brick or asbestos to avoid damage to the desk, or risk of fire. Three or four Bunsens, with wing tops, will supply enough heat for the experiment.

A thick walled 1 quart Woulfe bottle (E. and A. 7269) having 3 necks and an outlet at the bottom, is used as a receiver or hydraulic main. Large sized glass tubing, a heavy rubber connector, and a tubing clamp are used between the retort and receiver. Use a rubber stopper at the outlet of the retort since cork soon chars and allows gas and tar to escape. The tube leading into the bottle should reach nearly to the bottom. A second tube as long as the first and also reaching nearly to the bottom should be used through the middle neck of the bottle. Connect this with a funnel and place a tubing clamp upon the connector. By means of this funnel and the outlet tube, fresh water or liquor can be added from time to time and tar, bone oil or grease drawn off. Arrange the outlet tube to suit the experiment, in a similar manner. The exit tube should be very short, to avoid the splashing over of the liquor into the first wash bottle. If there is no Woulfe bottle at hand, use a bottle such as stick KOH is sold in, of about 1 l. capacity, fitted with a 3-hole rubber stopper and tubes. The gas pressure will force excess tar, etc., out of the third tube, on releasing the clamp and closing the exit tube and new water can be run in on releasing the exit tube.

Using clamps and connectors, arrange a train of at least three wash bottles to catch the light oils and ammoniacal vapors.

From this point, a variation is necessary, dependent upon the material to be distilled. For wood and bones, one or two wash bottles will be sufficient. But in distilling coal, place a 12" $CaCl_2$ tube filled with a mixture of moist sawdust and iron rust $Fe_2O_3 3H_2O$, in the train. After the experiment is concluded, test the iron rust for the presence of FeS. Report the results and conclusions drawn.

Although not strictly necessary, it is well to arrange one or two $CaCl_2$ tubes filled with slag or brick and having dropping funnels so the gas will receive a final cleansing while passing over the moist slag. The last traces of the ammonia compounds and hydrocarbons will be removed here. Finally, a gas holder or Bunsen completes the train of apparatus. Do not put more than 4" water in the receiver or more than 2" in the wash bottles.

After charging the retort and seeing that all clamps and connections are in place, heat the retort slowly to avoid sudden gas pressure or cracking of the receiver. Any loose connections will show at this time. At the end of the experiment, disconnect the retort, clamp it tightly, and loosen all other clamps so the liquor will not draw back from the wash bottles into the receiver. Keep the clamp upon the retort closed until it is cold.

Test the gas at the end of the train until it burns, then connect the gas holder. Keep changing the water in the $CaCl_2$ tubes and use this water in the receiver.

Coal.

1. Tar found in receiver.
2. Ammonia liquor in receiver, wash bottles, etc.
3. Some cresols carry over from the receiver into the first and second wash bottles.
4. Coke found in retort.
5. Coal gas, burning yellow or blue, according to the presence or absence of air. Medium amount of hydrocarbons.

Wood.

1. Tar found in receiver, and reddish pyroligneous acid or crude wood vinegar.
2. Pine oils or creosote oils found in the wash bottles, depending whether pine or hard wood was used. Very pungent odor. Pine oils greenish in color.
3. Charcoal found in retort. Save this for blow piping.
4. Wood gas, pungent in odor, burning blue when the sleeve of the Bunsen is closed and not burning when the sleeve is open. Apparently the gases come from the wood in the right proportions for perfect combustion. Gas apparently poor in hydrocarbons.

Bones.

1. Grease, ammonia liquor and *Dippel's oil* found in receiver.
2. Ammoniacal and pyridine compounds found in the wash bottles. Repulsive pyridine and picoline odor.
3. Bone charcoal found in retort.
4. Bone gas. Smoky yellow flame when sleeve of Bunsen is closed. Very hot blue flame when sleeve is open. Apparently this gas is rich in hydrocarbons, nauseous in odor.

Tests and Notes.

1. Test the wash bottle contents for NH_3 after distilling coal and bones.
2. Test for CH_3OH and CH_3COOH after distilling wood, in the red liquor.
3. Have the physics students test the candle power of the various gases with a photometer, against a standard candle, incandescent lamp, or amylacetate lamp.
4. By weighing the charge and the resulting coke, bone char, or charcoal, the percentage of each can be estimated.
5. Compare the per cent of coke produced by coals from different regions.

6. Compare the charcoal yield of white pine and oak or hickory.

7. Prepare wood vinegar by the distillation of the crude pyroligneous acid. Crude wood vinegar is sometimes sold as "Liquid Smoke" and used to cure meat. Collect the distillate between 100° and 120°. This contains most of the acetic acid. The distillate collected up to 100° contains acetone, CH_3OH, etc., etc.

8. If possible extract the bones with CS_2 before placing them in the retort. We have not carried out this experiment ourselves, but it could easily be performed, showing the source of a great deal of the soap stock of commerce.

9. To a small portion of the wood vinegar from (7) collected under 100° add I and KOH. Formation of iodoform proves the presence of acetone CH_3—O—CH_3.

10. No attempt was made to distil the coal tar, wood tar, or Dippel's oil as we did not have a suitable still and agitator.

11. Reference works: Thorpe's *Industrial Chemistry*, Perkin and Kipping's *Elementary Organic Chemistry*, *Bulletin No. 144* of the U. S. Dep't of Agriculture upon *Wood Turpentine.*

ARTICLES IN CURRENT PERIODICALS.

American Forestry for October; *Washington, D. C.; $2.00 per year, 20 cents a copy:* "Fish for the Forests" (with 9 illustrations), L. P. Kneipp; "A Forest of Stone" (with 9 illustrations), F. H. Knowlton; "Practical Tree Surgery" (with 33 illustrations), J. Franklin Collins; "What Is a National Forest" (with 5 illustrations), T. W. Venemann; "Forests, Lumber and Consumer" (with 1 illustration), E. T. Allen.

American Naturalist for October; *Garrison, N. Y.; $4.00 per year, 40 cents a copy:* "Sex-limited and Sex-linked Inheritance," T. H. Morgan; "Inheritance of Endosperm Texture in Sweet Waxy Hybrids of Maize," G. N. Collins and J. H. Kempton; "A Study of Variation in the Apple," W. J. Young; "Shorter Articles and Discussion: Variation and Correlation in the Mean Age at Marriage of Men and Women," Dr. J. Arthur Harris, Roxana H. Vivian—"Duplicate Genes," Sewall Wright; "Notes and Literature: A Study of Desert Vegetation," Charles E. Bessey.

Educational Psychology for October; *Warwick and York, Baltimore, Md.; $2.50 per year, 30 cents a copy:* "An Experimental Critique of the Binet-Simon Scale," Carl C. Brigham; "Further Experimental Researches on Learning to Spell," W. H. Winch; "A Comparison of the Arithmetical Abilities of Rural and City School Children," E. H. Taylor.

Journal of Geography for October; *Madison, Wis.; $1.00 per year, 15 cents a copy:* "In the Domain of the Hudson's Bay Company," Charles K. Leith; "Influence of the Mountains of the British Isles upon their History," Benjamin A. Stevens; "The Minimum Requirement," Robert M. Brown; "Suggested Means of Measuring Efficiency in the Teaching of Geography," R. H. Whitbeck.

Nature-Study Review for October; *Ithaca, N. Y.; $1.00 per year, 15 cents a copy:* "Elementary Science Course in Normal School," Ora May Carrol; "The Mourning Doves," Sarah V. Prueser; "Los Angeles Nature Study Exhibition," Charles Lincoln Edwards; "Elementary Agriculture," A. W. Nolan; "Should School Gardens Be Made to Show Financial Gains?" E. S. Sell; "School Gardening in Portland, Oregon," Alice V. Joyce; "Some Experiments for the Garden," J. W. Emery.

Popular Astronomy for October; *Northfield, Minn.; $3.50 per year; 35 cents a copy:* "Man's Place in the Universe," Hector Macpherson; "Building an Amateur's Observatory," Chas. L. Early; "The So-Called Ring Nebula in Lyra," Charles N. Holmes; "Observations of Nova (2) Gemi-

norum, 1913-14," Frederick C. Leonard; "Priceless Accessions to Whitin Observatory Wellesley College" (with Plates xxi to xxiv), Sarah F. Whiting; "A Systematic Search for Bright Novae," Leon Campbell; "Transit of Mercury 1914, November 7, as Visible in the United States," William F. Rigge; "How to Find the Constellations," Mary H. Dunovant, Sarah L. Mayes and Sarah W. Weinges; "Discovery of the Ninth Satellite of Jupiter," Seth B. Nicholson.

Popular Science Monthly for October; *Garrison, N. Y.; $3.00 per year, 30 cents a copy:* "Phenomena of Inheritance," Edwin G. Conklin; "The Coniferous Forests of Eastern North America," Roland M. Harper; "The Value of Research in the Development of National Health," Benjamin Moore; "The Cultivation of Waste Land," Dr. A. D. Hall; "Home Rule, the Hope of Municipal Democracy," Oswald Ryan; "The Political Mind of Foreign-born Americans," Dr. Abram Lipsky; "The Evolution of Service," William Patten.

School World for October; *Macmillan and Company, London, Eng.; 7s. 6d. per year, 6 pence a copy:* "Education and the War," T. R. and the Hon. A. Joseph Pease; "The Historical Antecedents of the War," F. J. C. Hearnshaw; "The War and the Buffer States: The First Phase" (with map), B. C. Wallis; "Vulgar Fractions v. Decimals," R. Wyke Bayliss; "Pensions: The Proposed National Scheme for Secondary School Teachers," H. P. Lunn; "Training of Teachers in New South Wales," A. Mackie.

Zeitschrift für den Physikalischen und Chemischen Unterricht for September; *Prof. D. F. Paske, Berlin, Dohlen, Friedbergstrasse 5; 6 numbers, $2.88, 12M per year:* "Versuche mit Wechselströmen und elektrischen Schwingungen," K. Schütt; "Versuche über das verschiedene Sehen mit den Zapfen und Stäbchen der Netzhaut," W. Merkelbach; "Die objektive Darstellung der Fallbeschleunigung," H. Dircks; "Versuche über die Änderung der Wertigkeit beim Kupfer," H. Rebenstorff. Kleine Mitteilungen: "Über einen neuen Apparat zur Demonstration des Prinzips der Wirkung und Gegenwirkung," H. Schoentjes; "Bestimmung der Ausdehnungskoeffizienten von festen Stoffen und Gasen in Schülerübungen," C. Hauschulz; "Eine optische Erscheinung an bewegten Drähten," Fr. Fricke; "Bremswirkung Foucaultscher Ströme," Th. Schröder; "Die Bewegung des Stromleiters im Magnetfeld," J. Kleiber; "Demonstration der Brownschen Molekularbewegung," Fr. Flade.

AMERICAN PETROLEUM PRODUCTS TO REPLACE EUROPEAN IMPORTS.

Several medicinal articles of which petroleum forms a large percentage were imported into the United States prior to the war, especially a carefully refined oil having about the consistency of a very light lubricating oil. This has been made, for convenience, in Baku, Russia, and some of it has been manufactured in the United States from petroleum distillates imported from Russia, and has been sold as "alboline," "petrolatum oil," etc. The working up of the trade for these oils on the basis of Russian raw material was largely a matter of pure chance, but not of necessity, inasmuch as oils of the same character can be readily produced from American petroleum, and in fact have been produced in small quantities for many years. Thus vaseline oil is a by-product in the manufacture of vaseline, and has been used for the same medicinal purposes for many years. There is no other product of petroleum manufactured abroad which is not also manufactured in the United States. Arrangements have been completed whereby American alboline will be on the United States market in quantity before the end of the present calendar year, whether hostilities cease or not. *Bulletin 599, U. S. Geological Survey.*

PROBLEM DEPARTMENT.

By I. L. Winckler,
Central High School, E. Cleveland, Ohio.

Readers of this magazine are invited to propose problems and send solutions of problems in which they are interested. Problems and solutions will be credited to their authors. Address all communications to I. L. Winckler, 32 Wymore Ave., E. Cleveland, Ohio.

396. *Selected.*

If p is a positive integer, show:

(a) that $p(p+1)(p-1)$ is a multiple of 6;

(b) that p^6-1 is a multiple of 7.

(a) I. *Solution by Walter C. Eells, Annapolis, Maryland.*

Since either $p+1$ or p is even the expression is divisible by 2.

Since $p-1$, p, $p+1$ are consecutive integers one of them is divisible by 3. Therefore the product $(p-1)p(p+1)$ is divisible by 6.

II. *Solution by Elmer Schuyler, Brooklyn, New York.*

It is true for $p = 2$. Suppose it true for p and show it holds for $p+1$. $(p+1)(p+2)p = (p+1)(p-1+3)p = p(p+1)(p-1)+3p(p+1) = 6M+3$ times some even number. Hence it is true for all values of p.

(b) I. *Solution by Elmer Schuyler, Brooklyn, New York, and Mabel Burdick, Stapleton, New York.*

This is true except when p is a multiple of 7. All numbers, not multiples of 7, take one of the forms $7m\pm1$, $7m\pm2$, $7m\pm3$.

Then $(7m\pm1)^6-1 = 7N+1-1 = 7N.$

$(7m\pm2)^6-1 = 7N+64-1 = 7N'.$

$(7m\pm3)^6-1 = 7N+729-1 = 7N''.$

Hence the theorem is true.

II. *Solution by Walter C. Eells, Annapolis, Maryland.*

This statement obviously is not true for $p = 7x$. $(x = 0, 1, 2, 3 \ldots)$

For other values it may be proved thus:

$$p^6-1 = (p-1)(p+1)(p^2+p+1)(p^2-p+1).$$

Every positive integer is of one of the forms

$$7x,\ 7x\pm1,\ 7x\pm2,\ 7x\pm3.\quad (x = 0, 1, 2, 3 \ldots)$$

All integers of the form $7x+1$ make factor $p-1$ a multiple of 7.

All integers of the form $7x-1$ make factor $p+1$ a multiple of 7.

All integers of the form $7x+2$, $7x-3$ make factor p^2+p+1 a multiple of 7.

All integers of the form $7x-2$, $7x+3$ make factor p^2-p+1 a multiple of 7.

$\therefore$ if p is a positive integer not a multiple of 7, p^6-1 is a multiple of 7.

III. *Solution by Norman Anning, Clayburn, B. C.*

If p is a positive integer divisible by 7, p^6 is divisible by 7 and p^6-1 is not divisible by 7.

If $p \equiv 1, 2, 3, 4, 5, 6 \pmod 7$.

Then $p^3 \equiv 1, 8, 27, 64, 125, 216 \pmod 7$.

$\equiv 1, 1, 6, 1, 6, 6 \pmod 7$.

$\equiv 1, 6 \pmod 7$.

and $p^6 \equiv 1, 36 \pmod 7 \equiv 1, 1 \pmod 7$.

From this it follows that p^6-1 is a multiple of 7.

397. *Proposed by Niel Beardsley, Woodstock, Ill.*

Solve: $x^4-y^4 = x^3+y^3.$ (1)

$x^2+y^2 = xy.$ (2)

I. *Solution by N. P. Pandya, Sojitra, India, and Nelson L. Roray, Metuchen, New Jersey.*

From (2) we have $x^2-xy+y^2 = 0$, $\therefore$ $x = -wy$, or $x = -w^2y$.

Substituting these values in (1) we have, putting $w^3 = 1$.

$wy^4-y^4 = 0$ (3), or $w^2y^4-y^4 = 0$ (4).

From (3) and (4) all the eight values of y are each equal to 0. $\therefore$ $x = 0$ in all eight cases.

II. *Solution by Elmer Schuyler, Brooklyn, N. Y.*

From (1) $x^4-y^4 = (x^2-xy+y^2)(x+y).$ (3)

$\therefore$ from (2) and (3) $x^4-y^4 = 0.$ (4)

From (4) $y = \pm x$, and $y = \pm ix$.

$\therefore$ $x = 0$, $y = 0$ (eight multiple).

III. *Solution by Mabel Burdick, Stapleton, N. Y.*

From (2) $y = \dfrac{1\pm i\sqrt{3}}{2}x.$

Substituting in (1), $x^4+\dfrac{1\pm i\sqrt{3}}{2}x^4 = x^3-x^3$, $\therefore$ $x^4 = 0$, multiple root of 4th order. To each value of x correspond two values of y; therefore there are eight pairs of equal roots, each 0, 0.

398. *Proposed by Grace E. Shoe, Denver, Colorado.*

Construct a triangle, having given one side, the circumradius and the inradius.

I. *Solution by Elmer Schuyler, Brooklyn, New York.*

Let a, R, r, denote the side, radius of circumcircle and radius of incircle, respectively.

Describe a circle of radius R. Draw in it a chord $= a$. Construct a triangle with this chord as a base, altitude on this chord $= r$, and angle opposite the base $= 90°+\frac{1}{2}A(\frac{1}{2}A$ is known). The vertex opposite a is the center of the incircle. Draw the incircle and from the extremities of a draw tangents to the incircle, obtaining ABC as the required triangle.

II. *Solution by Nelson L. Roray, Metuchen, New Jersey.*

Let R, r and a be the circumradius, inradius, and given side respectively.

With S as a center and radius = R construct a circle and draw a chord in it $= a$.

Construct the locus of I, center of incircle. This is evidently a straight line parallel to a such that the perpendicular sect between them is r.

Now $\overline{SI}^2 = R^2-2Rr$ (Lachlan, *Pure Geometry,* page 74, Ex. 3).

$= R(R-2r)$.

Hence construct SI, and with S as a center construct a circle with radius SI. Where this cuts the locus of I is the center of the incircle. The remainder of the construction is evident.

NOTE: From $\overline{SI}^2 = R(R-2r)$ it follows that r is not greater than $\frac{1}{2}$R.

399. *Proposed by Norman Anning, Chilliwack, B. C.*

A man travels directly eastward 25 miles per hour. Find the latitude if his days are 23 hr. 15 min. long, supposing that the earth is a sphere of radius **3960 miles.**

I. *Solution by Walter C. Eells, Annapolis, Maryland.*

Let R be the radius of the earth. L the traveller's latitude.

Then $2\pi R \cos L$ is the length of the parallel of latitude on which he is travelling.

Hence we have the equation

$$\frac{23\frac{1}{4}}{24}\cdot 2\pi R\cos L = 2\pi R\cos L - 25\times 23\tfrac{1}{4} \text{ which reduces to } \cos L = \frac{9300}{\pi R};$$

whence if $R = 3960$, $L = 41° 23' 22''$ north or south latitude.

[This should probably be $L = 41° 37' 22''$.—Editor.]

II. *Solution by Norman Anning, Chilliwack, B. C.*

Since 23 hr. 15 min. : 24 hr. = 31 : 32 = 31 : (31+1) the man will go around the world in 31 days and will travel $31\times 24\times 25 = 18{,}600$ miles. The cosine of the latitude is the ratio which this distance bears to 7920π miles, the length of the equator.

From $\cos L = \frac{155}{66\pi}$, $L = 41° 37'$.

III. *Solution by Nelson L. Roray, Metuchen, New Jersey.*

The following solution is based upon "Mean Solar Time."

The man travels east at the rate of $11\frac{1}{4}°$ per day, since 45 minutes of time are equivalent to $11\frac{1}{4}°$ of longitude. Hence to get back to his starting place will require 32 days, that is the circumference of the small circle on which he travels is 18,600 miles.

Therefore the radius of this circle $= \frac{9300}{\pi}$. Cos of latitude $= \frac{9300}{3960\pi}$

$\therefore$ latitude $= 41° 37' 22''$.

400. *Proposed by Hugo Brandt, Boston, Mass.*

Inside of a box with a rectangular base 32″ by 16″ and vertical walls 18″ high, take a point A in the vertical center line of one of the 16″ by 18″ walls, 4″ above the base. On the opposite wall, in its vertical center line, take three points, B, C, D, whose distances above the base are 12″, 13″, 14″, respectively. Find the shortest distance from A to each of the points B, C, D, the path to be on the inner surface of the box.

Solution by Daniel Kreth, Wellman, Iowa.

The shortest path from A to B is from A down 4″, then along the center line of the base 32″, then up on the opposite wall 12″, making 48″.

For the paths from A to C and D, suppose the ends are hinged to one of the sides and swung around so that they are in the same vertical plane and making a rectangle 64″ by 18″. The horizontal distance between A and C is 48″ and the difference of their heights above the base is 9″. Therefore $\sqrt{48^2+9^2} = 48.836''$ is the distance from A to C. Similarly the distance from A to D $= \sqrt{48^2+10^2} = 49.03''$.

Correction.

Solution of Problem 382 (June number of Magazine). Solution I, third part should read:

Every number is of the form $7m$, $7m\pm1$, $7m\pm2$, $7m\pm3$, and therefore every square is of the form $7m$, $7m+1$, $7m+4$, $7m+2$.

If neither a nor b is a multiple of 7, they must both be of the form $7m+1$, or both of the form $7m+2$, or both of the form $7m+4$, etc.

Solution II. The last sentence should be amended to read: "Since, when neither p nor q is a multiple of 7, p^6-1 and q^6-1 are, and . . .

Solution III. This is not a general solution of the problem but applies to one set of Pythagorean numbers only.

[The attention of the Editor was called to these defects by R. M. Mathews. Neil Beardsley also sent in a correction of Solution II.]

CREDIT FOR SOLUTIONS.

391. Nelson L. Roray, George Y. Sosnow. (2)
392. Mabel G. Burdick. (1)
394. Nelson L. Roray. (1)
396. Norman Anning, Mabel G. Burdick, M. H. Byrne, Walter C. Eells, C. M. Jhaveri, Daniel Kreth, R. M. Mathews, N. P. Pandya, Nelson L. Roray, Elmer Schuyler, P. K. Shah. (11)
397. Norman Anning, A. Babbitt, Mabel G. Burdick, Jay S. Morris, N. P. Pandya, Nelson L. Roray, Elmer Schuyler. (7)
398. Normal Anning, Mabel G. Burdick, William Feuerwerger, N. P. Pandya, Nelson L. Roray, Elmer Schuyler. (6)
399. Norman Anning, Melvin Berdahl, Walter C. Eells, N. P. Pandya, Nelson L. Roray. (5)
400. Daniel Kreth, Nelson L. Roray (one incorrect solution). (3)

Total number of solutions, 36.

PROBLEMS FOR SOLUTION.

Algebra.

411. *Proposed by A. Babbitt, Urbana, Ill.*

Solve: $2^x = 4x$.

412. *Proposed by F. X. Karrer, Nome, Alaska.*

A jeweler repairing a watch, placed the hour-hand upon the minute-hand pinion, and the minute-hand upon the hour-hand pinion and then set the watch at six o'clock, which was the correct time. He then gave the watch to the owner. The latter sometime later wishing to know the time of day, and not knowing that the hands had been changed, looked at his watch and found that it registered the correct time. What was the time of day?

Geometry.

413. *Proposed by Nelson L. Roray, Metuchen, N. J.*

ABCD is a parallelogram, E any point on AB, G any point on CD. AG and GB intersect DE and EC at H and F, respectively. Prove the line HF divides the parallelogram into two congruent trapezoids.

414. *Proposed by H. C. McMillin, Washington, Kansas.*

Construct a triangle given the circumcenter, orthocenter, and one vertex.

415. *Selected.*

Prove by elementary geometry that $d^2 = R^2—2Rr$ where R is the radius of the circum-circle, r the radius of the incircle of a triangle and d is the distance between these centers.

PANORAMIC VIEW OF CRATER LAKE NATIONAL PARK.

A striking panoramic view, in six colors, of Crater Lake National Park is the latest of the national park publications issued under the direction of Secretary Lane. This view shows the park as it would appear to an observer flying over it, the ridges, peaks, and valleys being shaded and colored in order to show the relief. This panorama, which may be purchased for twenty-five cents from the Superintendent of Documents, Government Printing Office, Washington, D. C., measures 16½x18 inches, and has a horizontal scale of one mile to the inch.

THE N. E. A. REPORT ON HIGH SCHOOL SCIENCE.

On page 732 of the November, 1914, issue of this Journal appears an unsigned contribution entitled "An N. E. A. Report on High School Science." This contribution misinterprets a preliminary report of the Biological Sub-Committee of the N. E. A., which report has not yet been published, nor finally acted upon by the Committee as a whole. The authorized report of the Committee will appear in an early issue of this Journal.

The various Committees of the N. E. A. working under the direction of the Commission on the Re-organization of Secondary Education, were appointed for the purpose of finding a truly psychological organization with reference to all school subjects, which may take the place of the present defective organization of subject matter. We wish to state that we believe the aims of our two sub-committees are, as defined above, entirely harmonious.

JAMES E. PEABODY,
Chairman of the Sub-Committee on Biology.
JOHN F. WOODHULL,
Chairman of the Sub-Committee on General Science.

This report came to us through our regular channels, it being understood that the matter was perfectly legitimate. Neither Mr. Peabody nor Dr. Woodhull are in any manner responsible for the printing of the report, indeed telegraphed that it be held. The matter, however, had been printed before the receipt of telegram.—*Ed.*

FLAME STANDARDS IN PHOTOMETRY.

An interesting circular on "Flame Standards in Photometry" has just been published by the Bureau of Standards, Department of Commerce.

Although an agreement has been reached regarding the relative values of the units of light in use in different countries, no one primary photometric standard has been generally adopted by the various governments. In Germany preference is given to the Hefner lamp, in England to the pentane lamp, and in France to the Carcel lamp. Each of these serves in its own country both as the primary standard and as a working standard, but for the photometry of electric lamps generally in accurate photometric work standardized electric incandescent lamps are used in all countries. In America a group of such lamps kept at the Bureau of Standards are considered as provisional primary standards serving to maintain the unit until a better primary standard shall have been devised. It is believed that the unit which has been agreed upon can be so maintained with an accuracy considerably above that with which it can be reproduced by reference to any of the so-called reproducible standards at present in use. In other words, the incandescent lamps have really been employed as primary standards, and the flame standards, which logically should play the part of primary standards, have been relegated to a subordinate position.

There is, however, a possibility of an appreciable drift in the value of the unit if there is no photometric standard accurately reproducible from its specifications which is capable of serving as a reliable check upon the electric standards. It has, therefore, appeared worth while to make a study of the best types of flame lamps to see how closely they would reproduce in the Bureau laboratory the values adopted by international agreement and also to find whether their reliability as primary standards could be increased by any changes in construction or in operation.

The Hefner and the pentane lamps as made at present divide honors; the latter is markedly superior as a practical standard, but individual pentane lamps do not agree, and until lamps can be independently made which shall give the same value the type can hardly be said to be reproducible. The Hefner lamp is so simple in construction that reproduction of lamps is relatively easy. Lamps now made show small differences due to slight departures from mean dimensions, but these differences can be made negligible by more careful construction. Great difficulty is experienced, however, in making accurate comparisons of working standards against Hefner lamps because of the very low intensity (0.9 candle) and the red color of the flame.

It is believed to be possible to apply the principle of the present pentane lamp in specially made, accurately specified lamps with interchangeable parts, and thus to obtain a closer agreement between lamps. Then by operating the lamps under definite conditions one should be able to obtain sufficient precision with either the Hefner or the pentane lamp to give a valuable check on the electric standards now in use.

RAILROADS NEEDED TO DEVELOP GOLD MINING IN ALASKA.

The advances in lodge-gold mining development in the Yukon basin of Alaska during 1912 were largely confined to the Fairbanks district, according to A. H. Brooks, of the United States Geological Survey. There was also a small lode mine in operation in the Innoko district, and a little work was done on lode prospects in the Chandalar, Fortymile, and other Yukon districts. Most of these localities of lode occurrence are so isolated that the cost of operation is almost prohibitive. It is only through reducing transportation costs by building railroads and wagon roads that any advances in the lode-mining industry of inland Alaska can be brought about. Generous railroad development in Alaska would result in the opening up of innumerable rich mineral districts.

MINNESOTA GREATEST IRON-ORE PRODUCER.

Minnesota far outranks all other states in the mining of iron ore, and during the last four years has contributed both in quantity and value considerably more than half the iron ore produced and marketed in the United States, according to the United States Geological Survey. In 1913 the total marketed production of iron ore in this country was 59,643,098 long tons, valued at $130,905,558, of which Minnesota contributed 36,603,331 tons, valued at $80,789,025. In 1912 Minnesota produced 34,249,813 long tons of iron ore, valued at $61,805,017. Because of its great wealth in iron ores and of their extended development, Minnesota ranks ninth among all the states in the total value of its mineral production. The value of the iron ore produced in the state represents considerably more than 90 per cent of the total output. The value of the mineral products of Minnesota in 1913, exclusive of iron ore, was $5,025,508. These include the products of the stone quarries and the clay pits.

EDUCATION CONFERENCE IN PITTSBURGH.

The fourth annual joint educational conference will be held on Friday and Saturday, November 27th and 28th, at the University of Pittsburgh by the following associations: Secondary Schools of the Upper Ohio Valley; College, Normal and High Schools; Classical Association of Pittsburgh and Vicinity; Principal's Round Table of Allegheny County; and the Superintendent's Round Table.

The pressing problem of the "Reorganization of Secondary Schools" will be the theme of the conference. This subject will be discussed by representatives of the National Commission who are working on this problem, by state education officials and prominent local educators.

FRIDAY, NOVEMBER 27TH, 2:00 P. M.

Soldier's Memorial.

"Reorganization of Secondary Schools," Dr. William Orr, Deputy Commissioner of Education of Massachusetts; Mr. C. D. Koch, Inspector of High Schools of Pennsylvania.

Section Meetings—3:30 p. m.

SATURDAY, NOVEMBER 28TH, 9:30 A. M.

Section Meetings—Each section will hear and discuss the report of a committee on "Proposed Plans for Reorganization of Secondary Schools in Terms of Local Conditions."

Address, "Our Secondary Schools," Dr. William M. Davidson, Superintendent of Schools, Pittsburgh, Pa.

VALUE OF ECOLOGICAL SURVEYS IN COURT.

Henry Chandler Cowles, Associate Professor of Plant Ecology in the University of Chicago, was engaged some time ago by the United States Department of Justice to make an investigation of a large tract of very valuable timber land in Arkansas which had been originally surveyed as lake. Professor Cowles' services as an ecological expert were secured to determine from the nature of the timber and other evidence whether or not the area could possibly have been lake as recently as the time of the original survey in 1847.

The investigation was made and testimony given, and the United States Judge of that district gave a sweeping decision in favor of the government's contention that the survey was fradulent. Last autumn Dr. Cowles studied other areas which were also in litigation, and in August of this year his deposition as to the result of his study was taken in the United States court in Chicago.

Among the interesting findings was that none of the areas returned as lake had any evidence of a beach line such as should have existed. But the most striking evidence of the fraudulency of the original survey was the existence of immense upland trees growing over all the areas, many of the trees being from two hundred to three hundred years old, and some of them from five hundred to a thousand.

This case is particularly interesting as being perhaps the first recognition of ecological methods in courts of law and as pointing out an entirely new method of gaining evidence as to the character of land during the centuries immediately preceding the present.

BOOKS RECEIVED.

A Laboratory Outline of Elementary Chemistry, by Alexander Smith, Columbia University. Pages vi+137. 12.5x18.5 cm. Paper. 1914. The Century Co., New York.

Essays and Addresses, by the late James C. Brown, University of Liverpool. Pages ix+208. 15x23 cm. Cloth. 1914. $2.00 net. J. and A. Churchill, London, Eng.

Elementary Mathematical Analysis, by Charles S. Slichter, University of Wisconsin. Pages xiv+490. 13x19 cm. Cloth. 1914. $2.50 net. McGraw-Hill Book Company, New York City.

Water Reptiles of the Past and Present, by Samuel W. Williston, University of Chicago. Pages vii+251. 17x25 cm. Cloth. 1914. $3.00 net. The University of Chicago Press.

Report on the Progress and Condition of the Illinois State Museum of Natural History for 1911 and 1912, by A. R. Crook, Curator. 73 pages. 15x22 cm. Springfield, Illinois.

Plane Geometry with Practical Problems, by Marquis J. Jewell, High School, Evanston, and George A. Harper, High School, Kenilworth, Ill. Pages xii+242. 14x19 cm. Cloth. 1914. (C) Row, Peterson and Company, Chicago.

Laboratory Outlines for Embryology, by Mary L. Harman, Kansas State Agricultural College. Pages vii+50. 14x20 cm. Cloth. 1914. 50 cents net. W. P. Blakiston's Son and Company, Philadelphia.

Second Course in Algebra, by William B. Fite, Columbia University. Pages v+247. 13.5x19 cm. Cloth. 1914. 90 cents. (C) D. C. Heath and Co., New York.

Trigonometry with the Theory and Use of Logarithms, by Troxime Bôcher, Harvard University and Harry D. Gaylord, Browne and Nichols School, Cambridge. Pages ix+142. 13x19 cm. Cloth. 1914. (C) Henry Holt and Company, New York.

Manual, High School Geography, by Charles R. Dryer. 96 pages. 11x16 cm. Cloth. 1914. American Book Company, Chicago.

Textbook on Wireless Telegraphy, by Rupert Stanley, Technical Institute, Belfast. Pages xiii+334. 15x23 cm. Cloth. 1914. $2.25. Longmans, Green and Co., New York.

Standard Algebra, revised by William J. Milne, New York State College for Teachers. 496 pages. 12.5x18 cm. Cloth. 1914. (C) American Book Company, New York.

Geometry of Four Dimensions, by Henry P. Manning, Brown University. Pages ix+348. 14x20 cm. Cloth. 1914. $2.00. (C) The Macmillan Company, New York.

Algebraic Invariants, by Leonard E. Dickson, University of Chicago. Pages x+100. 15x23.5 cm. Cloth. 1914. (C) John Wiley and Sons, New York.

Machine Drawing and Design, by David A. Low, University of London. Pages vii+248. 13x19 cm. Cloth. 1914. 75 cents. Longmans, Green and Co., New York.

A Handbook of Vocational Education, by Joseph S. Taylor, District Superintendent of Schools, New York. Pages xvi+225. 13.5x19 cm. Cloth. 1914. $1.00. The Macmillan Company, New York.

College Physiography, by Ralph S. Tarr, late of Cornell University and Lawrence Martin, University of Wisconsin. Pages xxii+837. 15.5x22 cm. Cloth. 1914. $3.50. The Macmillan Company, New York.

The Teaching of Biology in the Secondary School, by Francis E. Lloyd, McGill University and Maurice A. Bigelow, Columbia University. Pages viii+491. 14x20 cm. Cloth. 1914. (E) Longmans, Green and Co., New York.

The Essentials of College Botany, by Charles E. Bessey, University of Nebraska, and Ernst A. Bessey, Michigan, Agricultural College. Pages xiv+409. 13x19 cm. Cloth. 1914. (E) Henry Holt and Company, New York.

Constructive Textbook of Practical Mathematics, by Horace W. Marsh, Pratt Institute. Pages xiv+244. 14x21 cm. Cloth. 1914. (C) John Wiley and Sons, New York.

High School Geography, by Charles R. Dryer. 536 pages. 14.5x21 cm. Cloth. 1914. American Book Company, Chicago.

Mathematics for Agricultural Students, by Henry C. Wolff, University of Wisconsin. Pages ix+309. 13x19 cm. Cloth. 1914. $1.50 net (C) McGraw-Hill Book Company, New York.

Physiology and Hygiene, with Practical Exercises, by Buel P. Colton and Louis Murbach, Detroit Central High School. Pages x+388. 14x19 cm. Cloth. 1914. $1.00. (W) D. C. Heath and Company, Boston.

An Appeal Against Slaughter, by Marion E. Coville. 161 pages. 13x20 cm. Cloth. 1914. (W) C. W. Bardeen, Syracuse, New York.

BOOK REVIEWS.

Foundations of Chemistry, by A. A. Blanchard, Massachusetts Institute of Technology, and F. B. Wade, Shortridge High School, Indianapolis. Pages 446. 14x19 cm. Cloth, $1.25. 1914. American Book Company.

Opinions of teachers of chemistry as to what constitutes a satisfactory course for high schools differ so radically that it requires no little courage upon the part of any authors to launch a new text upon the troubled waters of contending views. It is refreshing to find in the new Blanchard and Wade a text avowedly for the purpose of using the subject matter of chemistry primarily for the teaching of boys and girls, letting any mastery of chemistry as a science, together with discussions of its applications in the various industries, home economics, agriculture, etc., play a subordinate part. The book will find large favor amongst teachers who seek general educational ends in chemistry rather than specialized features without sacrifice of the fundamentals of the subject as a secondary school study.

The book is exceptionally attractive in binding and typography. The chapters are of a length well suited for teaching ends—a sufficiently complete presentation of each topic in turn but not wearisome for the high school pupil. Excellent summaries, together with questions, follow each section. The absence throughout the first part of the book of formulae and chemical equations leads one to turn to the title page to reassure himself that the book is really a text in chemistry. Chemical expressions follow later when chemical phenomena and their significance demand expression.

The writer wishes to voice the opinion that in larger measure than in the older standard texts the value of the Blanchard and Wade will depend upon the character of the laboratory exercises accompanying it. Independently of its attractive style in the treatment of its topics, not a little of the charm of the book and of its worth as an educational means in the teaching of youth, is the absence from the text of much of the detailed steps of the preparation and properties of long lists of substances of comparatively small teaching worth. At all times it is the large relationships of relatively few substances that are made centers of interest, and the approach to these is through what pupils already know of them from the experiences of life. For instance, studies of combustion lead on to teachings concerning oxygen; and discussions of water of a general nature, and concerned more or less with its physical aspects, precedes the study of hydrogen. There is every reason to believe that transferring to the

laboratory in larger measure teachings concerning terms, industrial and technical processes, and discussions of facts of reference, will enable a return to science texts for high school pupils that arouse and establish for life a desire to know more of the subject studied. The Blanchard and Wade text leads off in this direction, and high school teachers of chemistry will welcome the departure we are sure.

The treatment of chemical theory is sufficiently comprehensive and exceptionally clear and teachable. One draws a long breath of relief at promise of better understanding by pupils of these parts of chemistry.

Whether the year of high school chemistry shall cover the whole text, or as suggested but the first twenty-four chapters of the book, the unity of the text and its gradation in the difficulties of treatment of subjects as pupils grow better able to understand chemical theory is a very happy arrangement. Teachers of high school chemistry will find it worth while to give this new book more than the usual consideration. H. B.

Experimental Studies in Electricity and Magnetism by Francis E. Nipher, Washington University, St. Louis. 73 pages. 16x24 cm. Cloth. 1914. $1.25. P. Blakiston's Son and Co., Philadelphia.

This little book contains a résumé of the interesting and valuable experiments of Professor Nipher bearing upon the nature of the electric discharge. He has investigated the many phases of the subject. The work will be of the highest interest to all physicists. There are 29 drawings and half-tones, as well as nine plates. It is well indexed. C. H. S.

Examples in Algebra, by Albert H. Wheeler, High School of Commerce, Worcester, Mass. Pages xiii+257. 14x19 cm. 90 cents. 1914. Little, Brown and Company, Boston.

This collection of 10,000 exercises which have been constructed by the author, covers the standard courses of study. It can be used with any textbook for reviews and is especially adapted for preparing students for college entrance requirements. It contains not only a large number of type forms and equations for drill in manipulations, but also excellent lists of problems and applications in geometry and physics. No doubt many teachers could secure better results by using this book instead of the usual textbook, since the necessary definitions and explanations could be readily supplied in the class room. A comprehensive index makes it easy to choose examples from different subject headings to illustrate principles.

H. E. C.

School Arithmetic, Primary Book, by Florian Cajori. Pages ix+283. 13x19 cm. 35 cents. 1914. The Macmillan Company, New York.

Large type, open spacing, pictures and diagrams, games and drill devices, problems dealing with real things of the daily life of the child should render the beginning of the study of arithmetic attractive to the pupil. The work throughout the book is arranged to secure economy of effort, habits of accuracy, and reasonable speed in performing the elementary operations. Special tests for measuring the arithmetical abilities of pupils are given at the close of the book. H. E. C.

Standard Algebra, Revised, by William J. Milne, late President of New York State College for Teachers, Albany, N. Y. Pages 496. 13x18 cm. 1914. American Book Company, New York.

Many teachers who have found Dr. Milne's algebras most satisfactory textbooks will be glad of the opportunity of using this revision of the *Standard Algebra.* It has been planned to meet the demands of colleges for general admission and the requirements of the course in algebra outlined by the Regents of the state of New York. While much of the traditional material has been retained, a large number of fresh problems

has been drawn from commercial practice and from geometry and physics. Several hundred supplementary exercises are provided in the closing pages. H E. C.

The Walsh-Suzzallo Arithmetics, by John H. Walsh, Associate Superintendent of Schools, the City of New York, and Henry Suzzallo, Professor of the Philosophy of Education, Teachers College, Columbia University. Book One. Pages x+246. 13x19 cm. 35 cents. 1914. Book Two. Pages x+518. 65 cents. 1914. D. C. Heath and Company, New York.

The experience of the authors in various fields of educational work enables them to present the subject of arithmetic from a new point of view, and assures material and methods in accord with the latest requirements. Among these requirements in arithmetic are that efficiency shall be secured in the lower grades by emphasizing fundamental processes; and that social and economic applications of arithmetic shall be taught in the upper grades in order to give grammar school children insight into the typical practices of modern life.

Book One, Fundamental Processes, covers the work up to the end of the sixth year of the elementary school; and *Book Two, Practical Applications,* contains work for the last half of the school. An examination of these books will lead many teachers to use them in their classes.

H. E. C.

Business Arithmetic, by C. M. Brookman, Formerly Head of Mathematics Department, High School of Commerce, Columbus, Ohio. Pages 250. 14x19 cm. 65 cents. 1914. American Book Company, New York.

By omitting all non-essentials and combining rules and explanations with the solutions of problems the author presents a one-term course in this subject. Short methods of calculation and checks, problem material and methods have been selected from actual business and the necessity of speed and accuracy is emphasized. In addition to the usual topics of commercial discounts, profits, banking, insurance, and so on, there are many problems dealing with manual training, parcel post, postal savings banks, the new tariff bill, the new federal banking law, and other new features of business life. It looks like a good book. H. E. C.

Family Expense Account, by Thirmuthis A. Brookman, formerly Head Department Mathematics, Upper and Lower High Schools, Berkeley, Cal. Pages vi+97. 20x15 cm. 60 cents. 1914. D. C. Heath and Company, New York.

In November, 1900, Mr. and Mrs. Woodward were married in Berkeley. He was earning $75.00 a month as a bookkeeper. Their family expense account for fourteen years serves as the basis for practical instruction in the "mathematics of money" underlying the simpler processes of investment and expenditure, and the solution of problems which naturally come up in the families of those living on small salaries.

It is interesting to see the skillful way in which the author has used the financial story of this family to furnish practice in arithmetical operations. Probably this is the minor benefit pupils will derive from the book. The knowledge gained regarding the keeping of accounts, deposits in savings banks, use of checks, investments, insurance, mortgages, and other real problems of daily life can not be obtained from the usual textbook, Moreover, "The details of daily expenditure for dress, pocket money, amusements, etc., develop questions of ethics which can only be solved by recognizing the advantages of simplicity regardless of one's neighbors' standards, and emphasize the honesty of living within one's income." There should be a place for this book in every secondary school. H. E. C.

Der Bau des Weltalls, by Prof. Dr. J. Scheiner. Fourth Edition. Pages 132. 13x18 cm. M 1.25. 1913.

Der Kalender, by Walter F. Wislicenus. Pages 118. 13x18 cm. M. 1.15. 1914. B. G. Teubner, Leipsic, Germany.

Teachers of science and mathematics will find many of the volumes in "Die Sammlung, Aus Natur und Geisteswelt" of personal interest, and that they contain much material which can be used in the c ass room.

Bändchen 24, *Der Bau des Weltalls,* presents in a non-technical and popular way the astronomical facts, principles, and methods which should be in the possession of all well-informed people. The titles of the chapters indicate the scope of the book: Die Stellung der Erde in Weltall; Der Gestirnte Himmel; Die Spektralanalyse; Die Sonne; Die Fixsterne und die Nebelflecken; Die äussere Bau des Weltalls.

Bändchen 69, *Der Kalender,* gives an excellent historical account of the calendar from earliest times and in various countries; describing the Julian, Gregorian, Hebrew, and Mohammedan calendars, and also the calendar of the first French republic. At the close is a table of the dates of Easter Sunday for the years 600-2000. H. E. C.

Elementary Mathematical Analysis, by Charles S. Slichter, Professor of Applied Mathematics, University of Wisconsin. Pages xiv+490. $2.50. 1914. McGraw-Hill Book Company, New York.

It is not possible to give an adequate review of this book within the limit set for this journal. One reads it with increasing interest, and tries to estimate the stronger grasp and broader view of mathematics, the greater preparedness, and the higher efficiency of those students who are fortunate enough to be given this year's work in mathematics rather than the usual three subjects of the freshman year. It is not a "Practical Mathematics" though it is practical mathematics in which there is coherency throughout, secured by the aim to emphasize the fundamental truths and principles of elementary analysis, and to make immediate and real applications.

The notion of *functionality* is predominant throughout the book. The material of elementary analysis is grouped about the consideration of three fundamental functions, (1) the power function, $y = ax^n$, (2) the simple periodic function, $y = a \sin mx$, and (3) the exponential function. The usual topics of trigonometry and analytic geometry are included and the necessary topics of college algebra except infinite series which can be studied better in the calculus.

As one would expect much use is made of graphical methods in developing principles and in solving problems. It would seem as if logarithmic coördinate paper is entitled to greater attention than is accorded it.

H. E. C.

Instant Addition Cards, by A. C. Palmer, Nevada, Iowa.

For the use of teachers in giving class drill in rapid addition. These cards are arranged so that any person can learn to read at a glance, (1) the sum of any column on the hundred cards, (2) the sum total of any card, (3) the sum total of any two cards of the set. These cards can be obtained from Mr. Palmer at 40 cents a set. H. E. C.

The Theory of Numbers, by Robert D. Carmichael, Associate Professor of Mathematics, Indiana University. Pages 94. 15x23 cm. $1.00. 1914.

Algebraic Invariants, by Leonard E. Dickson, Professor of Mathematics, University of Chicago. Pages vii+100. 15x23 cm. $1.00. 1914. John Wiley and Sons, New York.

These volumes are Nos. 13 and 14 of the Mathematical Monographs edited by Mansfield Merriman and Robert S. Woodward. The eleven

chapters of *Higher Mathematics,* the publication of which was discontinued in 1906, have since that date been revised and issued separately. It is the purpose of the editors to add other monographs to the series from time to time if there is sufficient demand.

The Theory of Numbers gives a clear treatment of the fundamentals of the subject and in the last chapter points out a few of the many topics and problems which arise in this field. High-school teachers of mathematics who desire to extend their study of mathematics will find this book of interest; and the large number of exercises will aid in the understanding of this subject.

Algebraic Invariants is an introduction to the classical theory of invariants of algebraic forms. In Part I, Illustrations, Geometrical Interpretations and Applications of Invariants and Covariants, the beginning is made with illustrations from plane analytics and the work progresses to the standpoint of linear transformations, their invariants and interpretations, employed in analytic projective geometry and modern algebra. Part II, Theory of Invariants in Non-symbolic Notation, treats of the algebraic properties of invariants and covariants. Part III gives an introduction to the symbolic notation of Aronhold and Clebsch. Numerous illustrative examples and fourteen sets of exercises aid in making this book available for self-instruction. These two monographs and all the others in the series are most valuable books of reference H. E. C.

Progressive Chemistry, Practical Experiments for Secondary Schools. Prepared by the Teachers of Chemistry in the High Schools of Minneapolis, Minn.—P. A. Davis, North High; Louis G. Cook, East High; Jessie F. Caplin, West High; B. T. Emerson, Central High and Kate McDermid, South High. 14x22.5x.6 cm. Cloth 1914. 35 cents. Published by the authors.

This is a laboratory manual of 64 pages bound in block form with perforated margin to facilitate tearing off the pages in case they are to be pasted into the note book. Space is left on each page for brief notes.

The expression of the directions is excellent so that pupils can hardly fail to understand just what to do. Necessary precautions are given where required.

Although the title of the manual suggests that emphasis has been laid on the "practical," a close acquaintance with the manual and its use in the Minneapolis schools will show that it is not so intensely practical as to exclude the study of fundamental principles. The so-called "practical" experiments such as the Babcock test for example, are used to illustrate something which has gone before. The charring effect of sulphuric acid is thus brought out in the Babcock test after sulphuric acid has first been studied. Similarily the making of baking powder serves to illustrate and apply chemical calculations.

This use of what has been previously gained is of course one of the best means of acquiring what is in the long run the most intensely practical thing that schools can teach, the power to apply what has already been gained. F. B. W.

Machine Drawing and Design, by David A. Low, University of London. Pages vii+248. 12.5x19 cm. Cloth. 1914. 75 cents. Longmans, Green and Co., New York.

A book written primarily for the young engineer and those who desire to become familiar with machine drawing, in the more simple phases, by self-instruction. There are two hundred twenty-nine splendidly executed drawings, with dimensions marked thereon, the purpose being for the person to copy these drawings from the dimensions given. Also certain drawings are to be made or completed from part of the design given, it

being absolutely necessary for the person to understand thoroughly the drawing before him, before he can successfully complete the design. Then, too, certain drawings are to be made from dimensions calculated by rules given in the text. There are numerous helpful rules, discussions and matter useful to an engineer. A complete index is given. There are many practical problems scattered throughout the text. It is well made mechanically and is of a convenient size to carry in one's pocket. C. H. S.

General Chemistry, Principles and Applications by Lyman C. Newell, Ph. D. (Johns Hopkins), Professor of Chemistry in Boston University and author of "Experimental Chemistry," "Descriptive Chemistry" and "Inorganic Chemistry for Colleges." Pages vi+410+xiv+174. 1914. No price slip with reviewer's copy. D. C. Heath and Company.

This new book from the hand of the well known author of the above listed texts seems to offer a course midway between the extremely experimental and the extremely descriptive character of his first two texts. As the preface informs us. "The author has aimed to include in this book not only the principles of chemistry universally regarded as an essential part of a well rounded course, but also numerous practical applications. This aim in the opinion of the reviewer is an excellent one and the author has succeeded to a considerable degree in thus blending the teaching of the fundamental principles with the setting forth of some of the more important applications. This method of treatment will probably in the long run be found more valuable both from the standpoint of true education and also from that of ultimate utility than the extremely superficial and really very slightly useful treatment of chemistry now so popular with some vocational extremists.

The book contains a laboratory manual bound in the back of the volume. The order of treatment of topics is in general systematic rather than natural. Thus oxygen, then hydrogen, then water, are studied rather than first the familiar substance water, followed by the discovery of its constituent elements and the detailed study of them. The order of treatment of the metals is that of the periodic arrangement. A commendable feature of the book is its separation of numerical problems from questions of other types at the ends of the chapters. F. B. W.

Rocky Mountain Flowers, An Illustrated Guide for Plant-Lovers and Plant-Users, by Frederick Edward Clements, Ph. D., Head of Department of Botany, University of Minnesota; State Botanist; Director of the Pike's Peak Alpine Laboratory, and Edith Schwartz Clements, Ph. D., Instructor in Botany, University of Minnesota and Pike's Peak Alpine Laboratory. 25 plates in color. 22 plates in black and white. Pages xix+392. 8 vo. 1914. The H. W. Wilson Company, White Plains, N. Y., and New York City.

This is a beautiful book in appearance and make, with its fine, large, clear type and the exquisitely colored plates of flowers. While the title would indicate that the book was intended to be "popular," attractive to the amateur, it is not "popular" in the usual manner. There is not a word of appreciation or comment in the book. The genera and families are carefully described in the usual scientific manner, but very concisely, and the species are determined by means of keys without descriptions.

The keys are very simple, all useless details being omitted and the more obvious characters selected for use in the determination. Only the most necessary scientific terms are used in the descriptions and keys.

The colored drawings are beautiful and will be a great help to the amateur botanist. W. W.

General Hygiene, by Frank Overton, A. M., M. D., author of Applied Physiology. 12 mo. Pages 382. American Book Company. 1914.

Personal Hygiene, by Frank Overton, A. M., M. D. 12 mo. Pages 240. American Book Company. 1913.

These two books are much alike, except that *General Hygiene* is of broader scope and is intended for older people, while *Personal Hygiene* is intended for young people, children of grammar school age. The books are very well written and are safe and sound in treatment. The treatment is conventional as well as the range of topics. In fact the books do not seem to come very close to everyday life needs of the average boy or girl. In my judgment they are likely to prove rather dull reading to the school boys and girls who must use them. W. W.

Hygiene for Girls, Individual and Community, by Florence Harvey Richards, M. D., Medical Director, William Penn High School, Instructor in Materia Medica and Therapeutics, Woman's Medical College of Pennsylvania. 12 mo. Pages xi+242. D. C. Heath & Co. 1913.

This is a good book. The basis of the book was a series of lectures to the girls of the freshman class of the Penn High School. The author has aimed to give a maximum of practical hygiene of everyday life with just enough anatomy and physiology to give a basis for understanding the hygiene. The book is full of practical advice with illustrations to make the topics clear. Some special features are entire chapters on tuberculosis, public work, emergencies, patent medicines, etc. W. W.

Mathematics, by C. A. Laisant, Examinateur d'admission et Répétiteur à l'Ecole Polytechnique, Paris, France. Pages viii+156. 13x19 cm. 1914. Doubleday, Page & Co., New York.

The aptitude of this distinguished mathematician for new tasks is shown by the simple directness of his treatment of the elements of mathematics for the use of teachers and parents in dealing with young children. It begins with the child when he can make marks with a pencil and carries on the work (or play) till he can understand something of arithmetic, algebra, geometry, and analytic geometry.

Emphasis is placed on the necessity of having the children as far as possible do the exercises on real objects; and there is a charm in many of these exercises, presented in striking form and often leading to formulas of advanced mathematics. There are various puzzles; and graphs are treated in a way to make their use practicable and real in the first mathematical education of children.

The author's point of view may be indicated by giving a few unrelated paragraphs from his final remarks.

"Up to the present you have studied nothing, but you have learned a certain number of useful things, by way of amusement. If you have made any effort, it has been purely a voluntary one on your part, nothing has been required from you, and, particularly, nothing from your memory."

"Henceforward you have not to do with play, but with work. You ought to subject yourself to intellectual efforts, perhaps also to some efforts of memory. They will be the less formidable because up to now your forces have been husbanded, and you know many more things than other children of your age who have been subjected to a sort of torture, that of forcing them to retain words in their minds without understanding anything about them."

Women have need of mathematical instruction just as much as men; everyday life, domestic economy, no less than the manufactures and arts whose applications have to do with our existence, require from us all a knowledge of the science of size and space. H. E. C.

The Fungi Which Cause Plant Disease, by F. L. Stevens. Pages ix+754. 15×22 cm. 1913. $4.00. The Macmillan Company, New York City.

This book is a welcome contribution to the literature available to the high school teacher. It is a means of identification for the American fungi which are recognized as causes of disease in economic plants. It contains technical descriptions of divisions, orders, families, genera and species. Keys accompany all of these divisions in which the number of subdivisions is great enough to demand such aid. A glossary of fifteen pages provides for the user who is not familiar with the terminology of the subject. There are 449 illustrations, most of the genera being represented in the list of figures by at least one species.

The hosts of each species are indicated in connection with the description of the parasite but there is no attempt to describe the effects of the disease upon the host, or to discuss remedial measures, these matters having been discussed in a previous work by the same author.

One would anticipate that the book would be found invaluable in solving the many prob'ems of identity that arise in the course of field and laboratory work as well as those that are brought to the attention of the teacher of botany by local agriculturalists. To the teacher of plant study in an agricultural high school it would be particularly valuab'e. W. L. E.

American Forest Trees, by Henry H. Gibson. pp. xv+708 17x25.5 cm. Published by the Hardwood Record, Chicago, 1913.

Of tree books we have plenty and there would possibly be little excuse for introducing another to the attention of the readers of this Journal were it not for the unique character of the one here reviewed. Most such books which are fami'iar to botanists are restricted to an acccount of such botanical characters of the trees as will enable one to identify them. The present book does not pretend to discuss botanical characters at all. It is written for the lumberman and the intelligent layman who is interested in the lumber rather more than in the tree.

The book gives several pages to each important lumber species of the United States. It supp'ies the facts as to range, area, annual cut, supply, wood character, finish, uses, and other interesting matters. It is such facts as these that the average high school teacher of botany is continually needing, but which he never gets in the course of his botanical training. A book such as this which gives them in interesting form is particularly welcome. It does not duplicate any of the books that we already have on our shelves.

Every tree within the limits of the United States that can be called a lumber tree is included within the book. Every tree that is an important source of lumber is discussed at length and illustrated by a full page photograph of excellent quality. Of special interest to eastern readers are the pictures and descriptions of the western timber trees, the lumber from which is just beginning to be important in eastern markets. W. L. E.

The Elementary Principles of General Biology, by James Francis Abbott. 12.5×18 cm. Pages xvi+329. 1914. The Macmillan Company.

The last few years have seen a renascence of interest in General Biology as a subject of elementary instruction. The ideal which is in the minds of the advocates of such a course appears to be that of a union of the life sciences into a single coherent course. In such a course there should be, obviously, such a complete union of botanical and zoölogical material that the pupil would not be compel'ed to double on his tracks in order to cover the two parallel lines. Unfortunately the larger number of courses in general biology and of textbooks in the subjetc have not achieved such a union. In the usual type of textbook the two sciences remain distinctly separate. In many cases the relations of the separate parts are so slight that they may be purchased as separate volumes.

Possibly one of the reasons that makers of textbooks have found it so diffcult to combine these two related sciences is that they have followed the old method of organizing their material upon a basis of structure. In the teaching profession there is a strong movement toward placing physiology before anatomy but authors have not yet recognized this movement very largely in their books. While the structural organization will give a definite and graded coherence to a textbook of botany, for instance, it does not follow that the same is true in general biology. Plainly, the anatomy of a plant and of an animal do not fall into the same category, nor do their phyllogenies fall into the same line of descent. Structurally, the two kingdoms represent two widely divergent lines of descent, and no literary effort will be able to bring them into close relation. On the other hand, the homology of the fundamental physiological processes and responses is striking.

Professor Abbott has entirely discarded the old categories in arranging his materials. He has seized upon the important principles of biology. as his outline and used his facts to develope and illustrate these principles. Possibly this may be best illustrated by the actual chapter headings. These are "Living Substance, Primary Functions, Metabolism, Growth, Tissue Differentiation, Ontogenesis, Variation and Heredity, Organic Response, Species and Their Origin." Structure is not omitted from the discussion, but it is relegated to the subordinate place in which it belongs. In every part of the book anatomy is taken up as demanded by the subject under discussion.

The book is written for college classes and cannot be recommended for the high school excepting as a reference work. It should be of interest to any high school teacher who wishes to keep abreast of modern thought in the pedagogics of his subject. The book reflects the major interest of its author in that zoölogy is somewhat more prominent than botany, but this will not interfere with its usefulness. W. E. L.

Inductive Geometry, by Col. C. W. Fowler, Superintendent and Professor of Mathematics in the Kentucky Military Institute, Lyndon, Ky. Third edition. Pages viii+52. 13×18 cm. Published by the author.

The three hundred fifty-two exercises in this book serve as an excellent introduction to and preparation for the usual textbook work in geometry. The exercises are well planned to give the pupils a clear idea of a geometrical proof, as well as to give the desirable practice in using compasses and ruler in drawing neat figures and in making constructions. The advantage of such introductory work is now realized by many teachers.

H. E. C.

The Groundwork of Arithmetic, A. Handbook for Teachers, by Margaret Punnett, B. A., Vice-Principal of the L. C. C. London Day Training College (University of London). Pages xi+234. 13x19 cm. $1.00. 1914. Longmans, Green & Co., London.

The work outlined in this book covers four or five years beginning with children of the age of six. It is divided into five sections to each of which a year, in general, may be given. The method of presenting the various subjects to the pupils is indicated by a series of teaching examples which suggest ways of dealing with the most important and typical parts of the subject.

Whenever a new process is to be taught the need and purpose of it is shown to the children by means of a simple instance or problem. The author has given many helpful and practical suggestions which will be appreciated by teachers of arithmetic. Books of exercises are published to accompany the last three sections. H. E. C.

A School Course in Geometry, by W. J. Dobbs, M. A., Sometime Foundation Scholar of St. John's College, Cambridge. Pages xxii+427. 13x19 cm. $1.00. 1914. Longmans, Green & Co., London.

Shall we have a geometry not based on the method of Euclid? Why not? Shall we introduce the angle functions early in geometry and use them to simplify proofs and processes? Why not? Shall we give high-school pupils an acquaintance with trigonometry, analytic geometry, and the elementary notions of calculus? Why not? The use of this book in several schools under favorable conditions would undoubtedly furnish satisfactory answers to these questions, and one might predict that the answers would be in the affirmative.

In the establishment of fundamental geometrical truths the author has applied systematically the elementary notions of rotation, translation, and folding, instead of proceeding, according to tradition, from the congruence of triangles. He claims the following advantages for this treatment: (1) That it runs parallel with the intuitive apprehension of the pupil; (2) that it leads more rapidly to the acquisition of knowledge; and (3) that it serves as a more efficient training of the geometrical sense.

This book does not read like an ordinary textbook, and the explanations are so clear and understandable that pupils ought to grasp them readily. The most important parts of trigonometry and analytic geometry are skillfully interwoven with the geometry, and simple differentiations and integrations are performed in getting the slope of curves and areas. There are 361 diagrams, and about 1000 exercises most of which are original and apply principles to the solution of practical problems. An examination of this book will prove of considerable interest to any teacher of geometry and will probably lead to a careful study of some parts of it, especially if he feels the need of extending his knowledge of mathematics.

H. E. C.

The Weather and Climate of Chicago, by Henry J. Cox and John H. Armington, U. S. Weather Bureau. Pages xxv+375. 17.5x24 cm. 147 tables. 99 figures. Cloth. 1914. $3.00 net. The University of Chicago Press.

Too much cannot be said in commendation of this splendid book. There are no adverse criticisms to be made. It is full of facts concerning the weather and climate of Chicago. It is a comprehensive study of the climatic conditions existing in Chicago since the establishment of the Weather Office in 1870. Temperature, precipitation, atmospheric moisture, cloudiness and sunshine, wind direction and velocity and barometric pressure are discussed in the order named. In Part I the temperature is studied in all of its various phases, many interesting and valuable tables and figures being given. Part II is devoted to the study of precipitation in all of its forms such as rain, hail, snow, sleet, dew and fog. The various tables of one kind and another here given enable one, at a glance almost, to learn the nature and amount of precipitation in Chicago for the past forty-five years. Much interesting and helpful information is given under Part IV, Cloudiness and Sunshine. The book is, indeed a valuable addition to the literature, and informational side of Chicago. Commercially, the book will be of great help to the many business enterprises in Chicago by enabling the heads of these concerns to determine more accurately the probable weather conditions which may exist and which might hinder or advance the completion of the enterprise as the case may be. It will be valuable, too, in all secondary schools situated in and near Chicago, when classes are studying in earth science the particular subjects of which it treats. Every person who wishes to know the history of Chicago in its various phases should own a copy. C. H. S.

State and County Educational Reorganization, by Ellwood P. Cubberley, Leland Stanford University. Pages xx+257. 14x20.5 cm. Cloth. 1914. $1.25. The Macmillan Company, New York.

The author of this book has certainly been very clever in formulating this constitution and school code for the hypothetical state of Osceola. The book shows that the author is thoroughly familiar with laws governing our school systems the country over. With this knowledge and his understanding as to just what laws should stand on our school statute books, he has here presented a code of school laws for any state and its counties and cities. It certainly would be to the everlasting advantage of every state in the Union if many of the school laws under which they are now being governed could be cast into the sea and the corresponding laws and suggestions in this book substituted therefor. Certainly our schools would work for a much higher efficiency not only from the point of view of better scholarship and training, but from that of a money cost as well. Everyone will not agree with all that is discussed in the book, yet at the same time there is no one who can prepare a better set of laws and regulations for any school system in any state. Every phase of school regulation is masterfully taken care of. The code is presented under the head of seventeen chapters divided into, altogether, forty-six articles, these being still further subdivided into two hundred sixty-two sections or special topics. It is a splendid book from cover to cover, interestingly written, and written in such a strong way that its statements will stand the test of the courts. Any committee or body of folk expecting to revise or make new school laws for their territory can not do better than to adopt the suggestions and statements made in this book. C. H. S.

Dialogues Concerning Two New Sciences, by Galileo Galilei, Translated from the Italian and Latin into English by Henry Crew and Alfonso De Salvio of Northwestern University. Pages xxv+300. 19x23.5 cm. Heavy board cloth back. 1914. $2.00. Macmillan Company, New York.

Here is a book which people interested in physics have been looking for for years. English physics teachers everywhere will welcome it, thanking the genius who had the inspiration and mental ability to bring about its translation. Physics teachers for years have heard Galileo mentioned as the father of modern physics, yet have had no means of substantiating the statements. Two other translations of these particular writings have been made, one in 1665 and the other in 1730, but these have all been practically lost or destroyed. It is to be understood that this book does not contain anywhere near all of the writings of this man, simply all of that which is directly valuable to the physicist. The translation is as literal as the subject will allow, not sacrificing too much at the expense of clearness. It is a splendid addition to physics literature, and is a book which all physics teachers should possess. C. H. S.

The Freshman and His College, a College Manual, by Francis C. Lockwood, Allegheny College. Pages vi+156. 12x17 cm. Cloth. 1913. 80 cents. D. C. Heath and Company, Boston.

The freshman needs at the beginning of his college course to "stop and look and listen." Dr. Lockwood's abounding sympathy with the life of the student and his intimate knowledge of the conditions under which most youth begin their college course has enabled him to prepare an exceptionally helpful and suggestive book. The chapters treat of the opportunity of college life, the meaning of college education, freshman difficulties and dangers, devotion to ideals, the good drudge habit, the choice of studies, and a series of illuminating suggestions on How to Study. Many people, not freshmen, would profit by the sane and inspiring view of life and service presented in the book. Every freshman who has the opportunity of using it will be fortunate. C. H. S.

American Red Cross Text-Book on Elementary Hygiene and Home Care of the Sick, by Delano and McIsaac. Pages 256. P. Blakiston's Son & Co., Philadelphia.

Here is an admirably conceived and executed text which contains a great deal of material of the greatest service to the teacher of home economics. General sanitation, sanitation of food supplies, of house furnishing and care, care of infants, children, and of the sick, and personal hygiene briefly treated, are some of the subjects presented which will most strongly appeal to her. It will be seen, therefore, that prevention of sickness has as large a place in the book as has home nursing.

The treatment is so clear, direct, and practical, that the book may be put into the hands of any woman or girl (above seventh grade age, one might perhaps add) without fear of confusion or lack of interest.

M. C. D.

The Efficient Kitchen, by Georgie Boynton Child. McBride, Nast & Co., New York. Price, $1.25.

This litt'e book will greatly interest the teacher of foods, particularly if she believes in including the problems of household management in her classroom instruction. Like Mrs. Frederick's "The New Housekeeping," it deals with the application of the spirit of scientific management to house work; but it differs greatly from this book in scope and method. It takes up in very definite, detailed, and practical fashion, the subject of "the planning and equipment of the modern labor-saving kitchen." Items discussed range from the relative merits of various sorts of hot water heaters, to the proper place for keeping the tea-kettle (and the enormous difference it makes in saving of time and labor, whether one finds the right places for keeping these often-used articles); from necessary qualifications of a good fireless cooker, to improved methods in dish-washing; from keeping of household accounts, to dimensions of the broom closet. Cost estimations are most carefully given for kitchen and dining room furnishings, down to the minutest detail, and include a variety of conditions and contingencies, so that they may apply equally to the "lightest of light housekeepers" and to the mistress of the isolated farmhouse.

M. C. D.

A Study of Foods, by Ruth Wardall, State University of Iowa, and Edna White, Ohio State University. Pages 174. 1914. Ginn & Co.

This is a compact, concise, up-to-date little manual containing an amazing amount of material in small space. The text consists of well-chosen proportions of dietetics, scientific and sanitary data concerning foods and food production, skillfully blended with suggestions and devices from practical housewifery. It presupposes no preliminary science training, and is so presented as to make a good appeal to that type of student who is so sure she is not going to be interested in science. The recipes are numerous, modern, and excellent, the experiments given are few and simple but well chosen; there is a minimum of experimental cookery presented. The exercises on cost as related to food values, home versus commercial production, anod recipe variations, are a strong feature. The lists of suggestive questions at the end of each section are well calculated to arouse students' interest in topics to which they might not have taken so kindly, if more boldly presented. The bibliography is full and explicit for each section, and includes not only standard and recent texts, but also unearths much good material hidden away in bulletins which deserve to be better known among high school teachers, and many of which could be had for the asking.

M. C. D.

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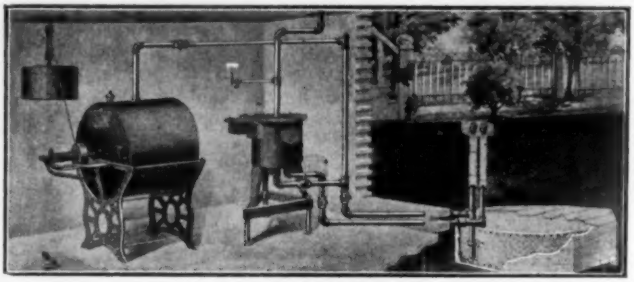

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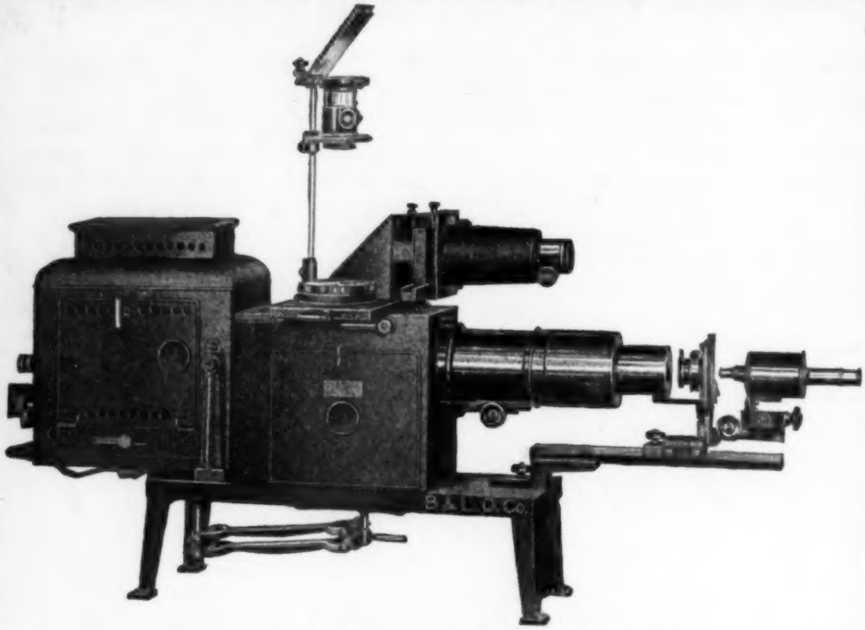

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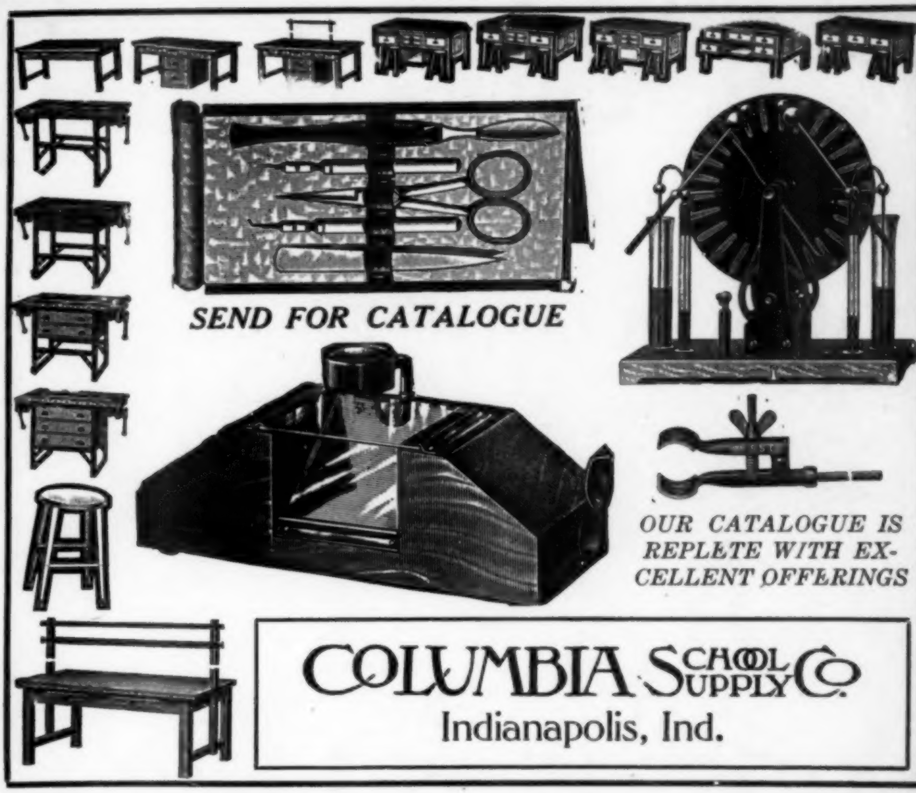
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